

Package ‘mlsurvlrnrs’

March 3, 2025

Title R6-Based ML Survival Learners for 'mlexperiments'

Version 0.0.5

Description Enhances 'mlexperiments'

<<https://CRAN.R-project.org/package=mlexperiments>> with additional machine learning ('ML') learners for survival analysis. The package provides R6-based survival learners for the following algorithms: 'glmnet' <<https://CRAN.R-project.org/package=glmnet>>, 'ranger' <<https://CRAN.R-project.org/package=ranger>>, 'xgboost' <<https://CRAN.R-project.org/package=xgboost>>, and 'rpart' <<https://CRAN.R-project.org/package=rpart>>. These can be used directly with the 'mlexperiments' R package.

License GPL (>= 3)

URL <https://github.com/kapsner/mlsurvlrnrs>

BugReports <https://github.com/kapsner/mlsurvlrnrs/issues>

Depends R (>= 4.1.0)

Imports data.table, kdry, mlexperiments, mllrnrs, R6, stats

Suggests glmnet, lintr, mlr3measures, ParBayesianOptimization, quarto, ranger, rpart, splitTools, survival, testthat (>= 3.0.1), xgboost

VignetteBuilder quarto

Config/testthat/edition 3

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SystemRequirements Quarto command line tools (<https://github.com/quarto-dev/quarto-cli>).

RoxygenNote 7.3.2

NeedsCompilation no

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Repository CRAN

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c_index	<i>c_index</i>
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Description

Calculate the Harrell's concordance index (C-index)

Usage

```
c_index(ground_truth, predictions)
```

Arguments

ground_truth A `survival::Surv` object with the ground truth.
 predictions A vector with predictions.

Details

A wrapper function around `glmnet::Cindex()` for use with `mlexperiments`.

See Also

[glmnet::Cindex\(\)](#)

Examples

```
set.seed(123)
gt <- survival::Surv(
  time = rnorm(100, 50, 15),
  event = sample(0:1, 100, TRUE)
)
preds <- rbeta(100, 2, 5)
```

```
c_index(gt, preds)
```

LearnerSurvCoxPHCox *R6 Class to construct a Cox proportional hazards survival learner*

Description

The LearnerSurvCoxPHCox class is the interface to perform a Cox regression with the survival R package for use with the mlexperiments package.

Details

Can be used with

- [mlexperiments::MLCrossValidation](#)

Super class

[mlexperiments::MLLearnerBase](#) -> LearnerSurvCoxPHCox

Methods

Public methods:

- [LearnerSurvCoxPHCox\\$new\(\)](#)
- [LearnerSurvCoxPHCox\\$clone\(\)](#)

Method `new()`: Create a new LearnerSurvCoxPHCox object.

Usage:

```
LearnerSurvCoxPHCox$new()
```

Returns: A new LearnerSurvCoxPHCox R6 object.

Examples:

```
LearnerSurvCoxPHCox$new()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvCoxPHCox$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

See Also

[survival::coxph\(\)](#)

Examples

```

# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

split_vector <- splitTools::multi_strata(
  df = dataset[, .SD, .SDcols = surv_cols],
  strategy = "kmeans",
  k = 4
)

train_x <- model.matrix(
  ~ -1 + .,
  dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
)
train_y <- survival::Surv(
  event = (dataset[, get("status")] |>
    as.character() |>
    as.integer()),
  time = dataset[, get("time")],
  type = "right"
)

fold_list <- splitTools::create_folds(
  y = split_vector,
  k = 3,
  type = "stratified",
  seed = seed
)

surv_coxph_cox_optimizer <- mlexperiments::MLCrossValidation$new(
  learner = LearnerSurvCoxPHCox$new(),
  fold_list = fold_list,
  ncores = 1L,
  seed = seed
)
surv_coxph_cox_optimizer$performance_metric <- c_index

# set data
surv_coxph_cox_optimizer$set_data(
  x = train_x,
  y = train_y
)

```

```

surv_coxph_cox_optimizer$execute()

## -----
## Method `LearnerSurvCoxPHCox$new`
## -----

LearnerSurvCoxPHCox$new()

```

LearnerSurvGlmnetCox *R6 Class to construct a Glmnet survival learner for Cox regression*

Description

The LearnerSurvGlmnetCox class is the interface to perform a Cox regression with the glmnet R package for use with the mlexperiments package.

Details

Optimization metric: C-index Can be used with

- [mlexperiments::MLTuneParameters](#)
- [mlexperiments::MLCrossValidation](#)
- [mlexperiments::MLNestedCV](#)

Super class

[mlexperiments::MLLearnerBase](#) -> LearnerSurvGlmnetCox

Methods

Public methods:

- [LearnerSurvGlmnetCox\\$new\(\)](#)
- [LearnerSurvGlmnetCox\\$clone\(\)](#)

Method `new()`: Create a new LearnerSurvGlmnetCox object.

Usage:

```
LearnerSurvGlmnetCox$new()
```

Returns: A new LearnerSurvGlmnetCox R6 object.

Examples:

```
LearnerSurvGlmnetCox$new()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvGlmnetCox$clone(deep = FALSE)
```

Arguments:

deep Whether to make a deep clone.

See Also

[glmnet::glmnet\(\)](#), [glmnet::cv.glmnet\(\)](#)

Examples

```
# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

param_list_glmnet <- expand.grid(
  alpha = seq(0, 1, .2)
)

ncores <- 2L

split_vector <- splitTools::multi_strata(
  df = dataset[, .SD, .SDcols = surv_cols],
  strategy = "kmeans",
  k = 4
)

train_x <- model.matrix(
  ~ -1 + .,
  dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
)

train_y <- survival::Surv(
  event = (dataset[, get("status")] |>
    as.character() |>
    as.integer()),
  time = dataset[, get("time")],
  type = "right"
)

fold_list <- splitTools::create_folds(
  y = split_vector,
  k = 3,
  type = "stratified",
```

```

    seed = seed
  )

  surv_glmnet_cox_optimizer <- mlexperiments::MLCrossValidation$new(
    learner = LearnerSurvGlmnetCox$new(),
    fold_list = fold_list,
    ncores = ncores,
    seed = seed
  )
  surv_glmnet_cox_optimizer$learner_args <- list(
    alpha = 0.8,
    lambda = 0.002
  )
  surv_glmnet_cox_optimizer$performance_metric <- c_index

  # set data
  surv_glmnet_cox_optimizer$set_data(
    x = train_x,
    y = train_y
  )

  surv_glmnet_cox_optimizer$execute()

  ## -----
  ## Method `LearnerSurvGlmnetCox$new`
  ## -----

  LearnerSurvGlmnetCox$new()

```

LearnerSurvRangerCox *R6 Class to construct a Ranger survival learner for Cox regression*

Description

The LearnerSurvRangerCox class is the interface to perform a Cox regression with the ranger R package for use with the mlexperiments package.

Details

Optimization metric: C-index Can be used with

- [mlexperiments::MLTuneParameters](#)
- [mlexperiments::MLCrossValidation](#)
- [mlexperiments::MLNestedCV](#)

Super class

[mlexperiments::MLLearnerBase](#) -> LearnerSurvRangerCox

Methods

Public methods:

- [LearnerSurvRangerCox\\$new\(\)](#)
- [LearnerSurvRangerCox\\$clone\(\)](#)

Method `new()`: Create a new `LearnerSurvRangerCox` object.

Usage:

```
LearnerSurvRangerCox$new()
```

Returns: A new `LearnerSurvRangerCox` R6 object.

Examples:

```
LearnerSurvRangerCox$new()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvRangerCox$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

See Also

[ranger::ranger\(\)](#)

Examples

```
# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

param_list_ranger <- expand.grid(
  sample.fraction = seq(0.6, 1, .2),
  min.node.size = seq(1, 5, 4),
  mtry = seq(2, 6, 2),
  num.trees = c(5L, 10L),
  max.depth = seq(1, 5, 4)
)

ncores <- 2L

split_vector <- splitTools::multi_strata(
```



```

    df = dataset[, .SD, .SDcols = surv_cols],
    strategy = "kmeans",
    k = 4
  )

  train_x <- model.matrix(
    ~ -1 + .,
    dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
  )
  train_y <- survival::Surv(
    event = (dataset[, get("status")] |>
      as.character() |>
      as.integer()),
    time = dataset[, get("time")],
    type = "right"
  )

  fold_list <- splitTools::create_folds(
    y = split_vector,
    k = 3,
    type = "stratified",
    seed = seed
  )

  surv_ranger_cox_optimizer <- mlexperiments::MLCrossValidation$new(
    learner = LearnerSurvRangerCox$new(),
    fold_list = fold_list,
    ncores = ncores,
    seed = seed
  )
  surv_ranger_cox_optimizer$learner_args <- as.list(
    data.table::data.table(param_list_ranger[1, ], stringsAsFactors = FALSE)
  )
  surv_ranger_cox_optimizer$performance_metric <- c_index

  # set data
  surv_ranger_cox_optimizer$set_data(
    x = train_x,
    y = train_y
  )

  surv_ranger_cox_optimizer$execute()

  ## -----
  ## Method `LearnerSurvRangerCox$new`
  ## -----

  LearnerSurvRangerCox$new()

```

LearnerSurvRpartCox *LearnerSurvRpartCox R6 class*

Description

This learner is a wrapper around `rpart::rpart()` in order to fit recursive partitioning and regression trees with survival data.

Details

Optimization metric: C-index * Can be used with

- `mlexperiments::MLTuneParameters`
- `mlexperiments::MLCrossValidation`
- `mlexperiments::MLNestedCV`

Implemented methods:

- `$fit` To fit the model.
- `$predict` To predict new data with the model.
- `$cross_validation` To perform a grid search (hyperparameter optimization).
- `$bayesian_scoring_function` To perform a Bayesian hyperparameter optimization.

Parameters that are specified with `parameter_grid` and / or `learner_args` are forwarded to `rpart`'s `control` argument (see `rpart::rpart.control()` for further details).

Super class

`mlexperiments::MLLearnerBase` -> `LearnerSurvRpartCox`

Methods

Public methods:

- `LearnerSurvRpartCox$new()`
- `LearnerSurvRpartCox$clone()`

Method `new()`: Create a new `LearnerSurvRpartCox` object.

Usage:

```
LearnerSurvRpartCox$new()
```

Details: This learner is a wrapper around `rpart::rpart()` in order to fit recursive partitioning and regression trees with survival data.

Examples:

```
LearnerSurvRpartCox$new()
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvRpartCox$clone(deep = FALSE)
```

Arguments:

deep Whether to make a deep clone.

See Also

```
rpart::rpart(), c_index(), rpart::rpart.control()
rpart::rpart(), c_index(),
```

Examples

```
# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

ncores <- 2L

split_vector <- splitTools::multi_strata(
  df = dataset[, .SD, .SDcols = surv_cols],
  strategy = "kmeans",
  k = 4
)

train_x <- model.matrix(
  ~ -1 + .,
  dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
)
train_y <- survival::Surv(
  event = (dataset[, get("status")] |>
    as.character() |>
    as.integer()),
  time = dataset[, get("time")],
  type = "right"
)

fold_list <- splitTools::create_folds(
  y = split_vector,
  k = 3,
  type = "stratified",
  seed = seed
)
```

```

surv_rpart_optimizer <- mlexperiments::MLCrossValidation$new(
  learner = LearnerSurvRpartCox$new(),
  fold_list = fold_list,
  ncores = ncores,
  seed = seed
)
surv_rpart_optimizer$learner_args <- list(
  minsplit = 10L,
  maxdepth = 20L,
  cp = 0.03,
  method = "exp"
)
surv_rpart_optimizer$performance_metric <- c_index

# set data
surv_rpart_optimizer$set_data(
  x = train_x,
  y = train_y
)

surv_rpart_optimizer$execute()

## -----
## Method `LearnerSurvRpartCox$new`
## -----

LearnerSurvRpartCox$new()

```

LearnerSurvXgboostAft R6 Class to construct a Xgboost survival learner for accelerated failure time models

Description

The `LearnerSurvXgboostAft` class is the interface to accelerated failure time models with the `xgboost` R package for use with the `mlexperiments` package.

Details

Optimization metric: needs to be specified with the learner parameter `eval_metric`. Can be used with

- [mlexperiments::MLTuneParameters](#)
- [mlexperiments::MLCrossValidation](#)
- [mlexperiments::MLNestedCV](#)

Also see the official `xgboost` documentation on aft models: https://xgboost.readthedocs.io/en/stable/tutorials/aft_survival_analysis.html

Super classes

`mlexperiments::MLLearnerBase` -> `mlrnrs::LearnerXgboost` -> `LearnerSurvXgboostAft`

Methods**Public methods:**

- `LearnerSurvXgboostAft$new()`
- `LearnerSurvXgboostAft$clone()`

Method `new()`: Create a new `LearnerSurvXgboostAft` object.

Usage:

```
LearnerSurvXgboostAft$new(metric_optimization_higher_better)
```

Arguments:

`metric_optimization_higher_better` A logical. Defines the direction of the optimization metric used throughout the hyperparameter optimization.

Returns: A new `LearnerSurvXgboostAft` R6 object.

Examples:

```
LearnerSurvXgboostAft$new(metric_optimization_higher_better = FALSE)
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvXgboostAft$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

See Also

`xgboost::xgb.train()`, `xgboost::xgb.cv()`

Examples

```
# execution time >2.5 sec
# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

param_list_xgboost <- expand.grid(
  objective = "survival:aft",
```

```

    eval_metric = "aft-nloglik",
    subsample = seq(0.6, 1, .2),
    colsample_bytree = seq(0.6, 1, .2),
    min_child_weight = seq(1, 5, 4),
    learning_rate = c(0.1, 0.2),
    max_depth = seq(1, 5, 4)
  )
  ncores <- 2L

  split_vector <- splitTools::multi_strata(
    df = dataset[, .SD, .SDcols = surv_cols],
    strategy = "kmeans",
    k = 4
  )

  train_x <- model.matrix(
    ~ -1 + .,
    dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
  )
  train_y <- survival::Surv(
    event = (dataset[, get("status")] |>
      as.character() |>
      as.integer()),
    time = dataset[, get("time")],
    type = "right"
  )

  fold_list <- splitTools::create_folds(
    y = split_vector,
    k = 3,
    type = "stratified",
    seed = seed
  )

  surv_xgboost_aft_optimizer <- mlexperiments::MLCrossValidation$new(
    learner = LearnerSurvXgboostAft$new(
      metric_optimization_higher_better = FALSE
    ),
    fold_list = fold_list,
    ncores = ncores,
    seed = seed
  )
  surv_xgboost_aft_optimizer$learner_args <- c(as.list(
    data.table::data.table(param_list_xgboost[1, ], stringsAsFactors = FALSE)
  ),
    nrounds = 45L
  )
  surv_xgboost_aft_optimizer$performance_metric <- c_index

  # set data
  surv_xgboost_aft_optimizer$set_data(
    x = train_x,
    y = train_y
  )

```

```

)

surv_xgboost_aft_optimizer$execute()

## -----
## Method `LearnerSurvXgboostAft$new`
## -----

LearnerSurvXgboostAft$new(metric_optimization_higher_better = FALSE)

```

LearnerSurvXgboostCox *R6 Class to construct a Xgboost survival learner for Cox regression*

Description

The LearnerSurvXgboostCox class is the interface to perform a Cox regression with the xgboost R package for use with the mlexperiments package.

Details

Optimization metric: needs to be specified with the learner parameter `eval_metric`. Can be used with

- [mlexperiments::MLTuneParameters](#)
- [mlexperiments::MLCrossValidation](#)
- [mlexperiments::MLNestedCV](#)

Super classes

[mlexperiments::MLLearnerBase](#) -> [mlrnrs::LearnerXgboost](#) -> LearnerSurvXgboostCox

Methods

Public methods:

- [LearnerSurvXgboostCox\\$new\(\)](#)
- [LearnerSurvXgboostCox\\$clone\(\)](#)

Method `new()`: Create a new LearnerSurvXgboostCox object.

Usage:

```
LearnerSurvXgboostCox$new(metric_optimization_higher_better)
```

Arguments:

`metric_optimization_higher_better` A logical. Defines the direction of the optimization metric used throughout the hyperparameter optimization.

Returns: A new LearnerSurvXgboostCox R6 object.

Examples:

```
LearnerSurvXgboostCox$new(metric_optimization_higher_better = FALSE)
```

Method `clone()`: The objects of this class are cloneable with this method.

Usage:

```
LearnerSurvXgboostCox$clone(deep = FALSE)
```

Arguments:

`deep` Whether to make a deep clone.

See Also

[xgboost::xgb.train\(\)](#), [xgboost::xgb.cv\(\)](#)

Examples

```
# execution time >2.5 sec
# survival analysis

dataset <- survival::colon |>
  data.table::as.data.table() |>
  na.omit()
dataset <- dataset[get("etype") == 2, ]

seed <- 123
surv_cols <- c("status", "time", "rx")

feature_cols <- colnames(dataset)[3:(ncol(dataset) - 1)]

param_list_xgboost <- expand.grid(
  objective = "survival:cox",
  eval_metric = "cox-nloglik",
  subsample = seq(0.6, 1, .2),
  colsample_bytree = seq(0.6, 1, .2),
  min_child_weight = seq(1, 5, 4),
  learning_rate = c(0.1, 0.2),
  max_depth = seq(1, 5, 4)
)
ncores <- 2L

split_vector <- splitTools::multi_strata(
  df = dataset[, .SD, .SDcols = surv_cols],
  strategy = "kmeans",
  k = 4
)

train_x <- model.matrix(
  ~ -1 + .,
  dataset[, .SD, .SDcols = setdiff(feature_cols, surv_cols[1:2])]
)
```



```

)
train_y <- survival::Surv(
  event = (dataset[, get("status")] |>
    as.character() |>
    as.integer()),
  time = dataset[, get("time")],
  type = "right"
)

fold_list <- splitTools::create_folds(
  y = split_vector,
  k = 3,
  type = "stratified",
  seed = seed
)

surv_xgboost_cox_optimizer <- mlexperiments::MLCrossValidation$new(
  learner = LearnerSurvXgboostCox$new(
    metric_optimization_higher_better = FALSE
  ),
  fold_list = fold_list,
  ncores = ncores,
  seed = seed
)
surv_xgboost_cox_optimizer$learner_args <- c(as.list(
  data.table::data.table(param_list_xgboost[1, ], stringsAsFactors = FALSE)
),
nrounds = 45L
)
surv_xgboost_cox_optimizer$performance_metric <- c_index

# set data
surv_xgboost_cox_optimizer$set_data(
  x = train_x,
  y = train_y
)

surv_xgboost_cox_optimizer$execute()

## -----
## Method `LearnerSurvXgboostCox$new`
## -----

LearnerSurvXgboostCox$new(metric_optimization_higher_better = FALSE)

```

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