Package 'mlr3spatiotempcv'

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Title Spatiotemporal Resampling Methods for 'mlr3'

Version 2.3.5

Description Extends the mlr3 machine learning framework with spatio-temporal resampling methods to account for the presence of spatiotemporal autocorrelation (STAC) in predictor variables. STAC may cause highly biased performance estimates in cross-validation if ignored. A JSS article is available at <doi:10.18637/jss.v111.i07>.

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URL https://mlr3spatiotempcv.mlr-org.com/, https://github.com/mlr-org/mlr3spatiotempcv, https://mlr3book.mlr-org.com

BugReports https://github.com/mlr-org/mlr3spatiotempcv/issues

Depends mlr3 (>= 0.12.0), R (>= 3.5.0)

Imports checkmate, data.table, ggplot2 (>= 3.4.0), mlr3misc (>= 0.11.0), paradox, R6, utils

Suggests bbotk, blockCV (>= 3.1.2), caret, CAST (>= 0.8.0), ggsci, ggtext, here, knitr, lgr, mlr3filters (>= 0.7.0.9000), mlr3pipelines, mlr3spatial, mlr3tuning, patchwork, plotly, rmarkdown, rpart, sf, sperrorest, terra, testthat (>= 3.0.0), twosamples, vdiffr (>= 1.0.0), withr

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Collate 'aaa.R' 'ResamplingRepeatedSpCVBlock.R' 'ResamplingRepeatedSpCVCoords.R' 'ResamplingRepeatedSpCVDisc.R' 'ResamplingRepeatedSpCVEnv.R' 'ResamplingRepeatedSpCVTiles.R' 'ResamplingRepeatedSpCVknndm.R' 'ResamplingRepeatedSptCVCstf.R'

'ResamplingSpCVBlock.R' 'ResamplingSpCVBuffer.R'
'ResamplingSpCVCoords.R' 'ResamplingSpCVDisc.R'
'ResamplingSpCVEnv.R' 'ResamplingSpCVKnndm.R'
'ResamplingSpCVTiles.R' 'ResamplingSptCVCstf.R'
'TaskClassifST.R' 'TaskRegrST.R' 'Task_classif_diplodia.R'
'Task_classif_ecuador.R' 'Task_regr_cookfarm_profiles.R'
'as_task_classif_st.R' 'as_task_regr_st.R' 'autoplot.R'
'autoplot_all_folds_dt.R' 'autoplot_all_folds_list.R'
'autoplot_multi_fold_dt.R' 'autoplot_multi_fold_list.R'
'autoplot_spcv_cstf.R' 'bibentries.R' 'helper.R'
'helper_DataBackend.R' 'helper_autoplot.R' 'reexports.R'
'zzz.R'

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Contents

mlr3spatiotempcv-package 3
as_task_classif_st 5
as_task_regr_st.TaskClassifST 7
autoplot.ResamplingCustomCV 10
autoplot.ResamplingCV 11
autoplot.ResamplingSpCVBlock 13
autoplot.ResamplingSpCVBuffer 16
autoplot.ResamplingSpCVCoords 18
autoplot.ResamplingSpCVDisc 20
autoplot.ResamplingSpCVEnv 22
autoplot.ResamplingSpCVKnndm 24
autoplot.ResamplingSpCVTiles 27
autoplot.ResamplingSptCVCstf 29
mlr_resamplings_repeated_spcv_block 32
mlr_resamplings_repeated_spcv_coords 36
mlr_resamplings_repeated_spcv_disc 38
mlr_resamplings_repeated_spcv_env 40
mlr_resamplings_repeated_spcv_knndm 42
mlr_resamplings_repeated_spcv_tiles 46
mlr_resamplings_repeated_sptcv_cstf 49
mlr_resamplings_spcv_block 51
mlr_resamplings_spcv_buffer 54
mlr_resamplings_spcv_coords 56

mlr_resamplings_spcv_disc 58
mlr_resamplings_spcv_env 60
mlr_resamplings_spcv_kndm 61
mlr_resamplings_spcv_tiles 64
mlr_resamplings_sptcv_cstf 67
mlr_tasks_cookfarm_mlr3 69
mlr_tasks_diplodia 70
mlr_tasks_ecuador 71
TaskClassifST 71
TaskRegrST 74

Index **77**

`mlr3spatiotempcv-package`

mlr3spatiotempcv: Spatiotemporal Resampling Methods for 'mlr3'

Description

Extends the mlr3 machine learning framework with spatio-temporal resampling methods to account for the presence of spatiotemporal autocorrelation (STAC) in predictor variables. STAC may cause highly biased performance estimates in cross-validation if ignored. A JSS article is available at doi:10.18637/jss.v111.i07.

Main resources

- Book on mlr3: `https://mlr3book.mlr-org.com`
- mlr3book section about spatiotemporal data: `https://mlr3book.mlr-org.com/chapters/chapter13/beyond_regression_and_classification.html#spatiotemp-cv`
- package vignettes: `https://mlr3spatiotempcv.mlr-org.com/dev/articles/`

Miscellaneous mlr3 content:

- Use cases and examples: `https://mlr3gallery.mlr-org.com`
- More classification and regression tasks: **mlr3data**
- Connector to OpenML: **mlr3oml**
- More classification and regression learners: **mlr3learners**
- Even more learners: `https://github.com/mlr-org/mlr3extralearners`
- Preprocessing and machine learning pipelines: **mlr3pipelines**
- Tuning of hyperparameters: **mlr3tuning**
- Visualizations for many **mlr3** objects: **mlr3viz**
- Survival analysis and probabilistic regression: **mlr3proba**
- Cluster analysis: **mlr3cluster**
- Feature selection filters: **mlr3filters**
- Feature selection wrappers: **mlr3fselect**
- Interface to real (out-of-memory) data bases: **mlr3db**

- Performance measures as plain functions: **mlr3measures**
- Parallelization framework: **future**
- Progress bars: **progressr**

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References

Schratz P, Muenchow J, Iturritxa E, Richter J, Brenning A (2019). "Hyperparameter tuning and performance assessment of statistical and machine-learning algorithms using spatial data." *Ecological Modelling*, **406**, 109–120. doi:10.1016/j.ecolmodel.2019.06.002.

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

Meyer H, Reudenbach C, Hengl T, Katurji M, Nauss T (2018). "Improving performance of spatio-temporal machine learning models using forward feature selection and target-oriented validation." *Environmental Modelling & Software*, **101**, 1–9. doi:10.1016/j.envsoft.2017.12.001.

Zhao Y, Karypis G (2002). "Evaluation of Hierarchical Clustering Algorithms for Document Datasets." *11th Conference of Information and Knowledge Management (CIKM)*, 51-524. doi:10.1145/584792.584877.

See Also

Useful links:

- https://mlr3spatiotempcv.mlr-org.com/
- https://github.com/mlr-org/mlr3spatiotempcv
- https://mlr3book.mlr-org.com
- Report bugs at https://github.com/mlr-org/mlr3spatiotempcv/issues

`as_task_classif_st` *Convert to a Spatiotemporal Classification Task*

Description

Convert an object to a TaskClassifST. This is a S3 generic for the following objects:

1. TaskClassifST: Ensure the identity.
2. `data.frame()` and mlr3::DataBackend: Provides an alternative to the constructor of TaskClassifST.
3. sf::sf: Extracts spatial meta data before construction.
4. mlr3::TaskRegr: Calls `mlr3::convert_task()`.

Usage

```
as_task_classif_st(x, ...)

## S3 method for class 'TaskClassifST'
as_task_classif_st(x, clone = FALSE, ...)

## S3 method for class 'data.frame'
as_task_classif_st(
  x,
  target,
  id = deparse(substitute(x)),
  positive = NULL,
  coordinate_names,
  crs = NA_character_,
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)

## S3 method for class 'DataBackend'
as_task_classif_st(
  x,
  target,
  id = deparse(substitute(x)),
  positive = NULL,
  coordinate_names,
  crs,
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)
```

```
## S3 method for class 'sf'
as_task_classif_st(
  x,
  target = NULL,
  id = deparse(substitute(x)),
  positive = NULL,
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)
```

Arguments

x	(any) Object to convert.
...	(any) Additional arguments.
clone	(logical(1)) If TRUE, ensures that the returned object is not the same as the input x.
target	(character(1)) Name of the target column.
id	(character(1)) Id for the new task. Defaults to the (deparsed and substituted) name of the data argument.
positive	(character(1)) Only for binary classification: Name of the positive class. The levels of the target columns are reordered accordingly, so that the first element of $class_names is the positive class, and the second element is the negative class.
coordinate_names	(character(1)) The column names of the coordinates in the data.
crs	(character(1)) Coordinate reference system. WKT2 or EPSG string.
coords_as_features	(logical(1)) If TRUE, coordinates are used as features. This is a shortcut for task$set_col_roles(c("x", "y"), role = "feature") with the assumption that the coordinates in the data are named "x" and "y".
label	(character(1)) Label for the new instance. Shown in as.data.table(mlr_tasks).

Value

TaskClassifST.

Examples

```
if (mlr3misc::require_namespaces(c("sf"), quietly = TRUE)) {
  library("mlr3")
  data("ecuador", package = "mlr3spatiotempcv")

  # data.frame
  as_task_classif_st(ecuador, target = "slides", positive = "TRUE",
    coords_as_features = FALSE,
    crs = "+proj=utm +zone=17 +south +datum=WGS84 +units=m +no_defs",
    coordinate_names = c("x", "y"))

  # sf
  ecuador_sf = sf::st_as_sf(ecuador, coords = c("x", "y"), crs = 32717)
  as_task_classif_st(ecuador_sf, target = "slides", positive = "TRUE")
}
```

---

as_task_regr_st.TaskClassifST

Convert to a Spatiotemporal Regression Task

Description

Convert object to a TaskRegrST.

This is a S3 generic, specialized for at least the following objects:

1. TaskRegrST: Ensure the identity.
2. `data.frame()` and mlr3::DataBackend: Provides an alternative to the constructor of TaskRegrST.
3. sf::sf: Extracts spatial meta data before construction.
4. mlr3::TaskClassif: Calls `mlr3::convert_task()`.

Usage

```
## S3 method for class 'TaskClassifST'
as_task_regr_st(
  x,
  target = NULL,
  drop_original_target = FALSE,
  drop_levels = TRUE,
  ...
)

as_task_regr_st(x, ...)

## S3 method for class 'TaskRegrST'
as_task_regr_st(x, clone = FALSE, ...)
```

```
## S3 method for class 'data.frame'
as_task_regr_st(
  x,
  target,
  id = deparse(substitute(x)),
  coordinate_names,
  crs = NA_character_,
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)

## S3 method for class 'DataBackend'
as_task_regr_st(
  x,
  target,
  id = deparse(substitute(x)),
  positive = NULL,
  coordinate_names,
  crs,
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)

## S3 method for class 'sf'
as_task_regr_st(
  x,
  target = NULL,
  id = deparse(substitute(x)),
  coords_as_features = FALSE,
  label = NA_character_,
  ...
)

## S3 method for class 'TaskClassifST'
as_task_regr_st(
  x,
  target = NULL,
  drop_original_target = FALSE,
  drop_levels = TRUE,
  ...
)
```

Arguments

x	(any) Object to convert.

`target` (`character(1)`)
Name of the target column.

`drop_original_target` (`logical(1)`)
If `FALSE` (default), the original target is added as a feature. Otherwise the original target is dropped.

`drop_levels` (`logical(1)`)
If `TRUE` (default), unused levels of the new target variable are dropped.

`...` (any)
Additional arguments.

`clone` (`logical(1)`)
If `TRUE`, ensures that the returned object is not the same as the input `x`.

`id` (`character(1)`)
Id for the new task. Defaults to the (deparsed and substituted) name of the data argument.

`coordinate_names` (`character(1)`)
The column names of the coordinates in the data.

`crs` (`character(1)`)
Coordinate reference system. WKT2 or EPSG string.

`coords_as_features` (`logical(1)`)
If `TRUE`, coordinates are used as features. This is a shortcut for `task$set_col_roles(c("x", "y"), role = "feature")` with the assumption that the coordinates in the data are named `"x"` and `"y"`.

`label` (`character(1)`)
Label for the new instance. Shown in `as.data.table(mlr_tasks)`.

`positive` (`character(1)`)
Only for binary classification: Name of the positive class. The levels of the target columns are reordered accordingly, so that the first element of `$class_names` is the positive class, and the second element is the negative class.

Value

TaskRegrST

Examples

```
if (mlr3misc::require_namespaces(c("sf"), quietly = TRUE)) {
  library("mlr3")
  data("cookfarm_mlr3", package = "mlr3spatiotempcv")

  # data.frame
  as_task_regr_st(cookfarm_mlr3, target = "PHIHOX",
    coords_as_features = FALSE, crs = 26911,
    coordinate_names = c("x", "y"))
```

```
  # sf
  cookfarm_sf = sf::st_as_sf(cookfarm_mlr3, coords = c("x", "y"), crs = 26911)
  as_task_regr_st(cookfarm_sf, target = "PHIHOX")
}
```

`autoplot.ResamplingCustomCV` *Visualization Functions for Non-Spatial CV Methods.*

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods.

Usage

```
## S3 method for class 'ResamplingCustomCV'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingCustomCV'
plot(x, ...)
```

Arguments

`object`	`[Resampling]` mlr3 spatial resampling object of class mlr3::ResamplingCustomCV.
`task`	`[TaskClassifST]/[TaskRegrST]` mlr3 task object.
`fold_id`	`[numeric]` Fold IDs to plot.
`plot_as_grid`	`[logical(1)]` Should a gridded plot using via **patchwork** be created? If `FALSE` a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument `fold_id`.
`train_color`	`[character(1)]` The color to use for the training set observations.
`test_color`	`[character(1)]` The color to use for the test set observations.

sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
x	[Resampling] mlr3 spatial resampling object of class mlr3::ResamplingCustomCV.

See Also

- mlr3book chapter on "Spatial Analysis"
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingSpCVDisc()
- autoplot.ResamplingSpCVTiles()
- autoplot.ResamplingCV()
- autoplot.ResamplingSptCVCstf()

Examples

```
if (mlr3misc::require_namespaces(c("sf", "patchwork"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  breaks = quantile(task$data()$dem, seq(0, 1, length = 6))
  zclass = cut(task$data()$dem, breaks, include.lowest = TRUE)

  resampling = rsmp("custom_cv")
  resampling$instantiate(task, f = zclass)

  autoplot(resampling, task) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
  autoplot(resampling, task, fold_id = 1)
  autoplot(resampling, task, fold_id = c(1, 2)) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingCV *Visualization Functions for Non-Spatial CV Methods.*

Description

Generic S3 plot() and autoplot() (ggplot2) methods.

Usage

```
## S3 method for class 'ResamplingCV'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedCV'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingCV'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedCV'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class mlr3::ResamplingCV or mlr3::ResamplingRepeatedCV.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)] The color to use for the training set observations.
test_color	[character(1)] The color to use for the test set observations.

sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
repeats_id	[numeric] Repetition ID to plot.
x	[Resampling] mlr3 spatial resampling object of class mlr3::ResamplingCV or mlr3::ResamplingRepeatedCV.

See Also

- mlr3book chapter on "Spatial Analysis"
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingSpCVDisc()
- autoplot.ResamplingSpCVTiles()
- autoplot.ResamplingSptCVCstf()

Examples

```
if (mlr3misc::require_namespaces(c("sf", "patchwork", "ggtext", "ggsci"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("cv")
  resampling$instantiate(task)

  autoplot(resampling, task) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
  autoplot(resampling, task, fold_id = 1)
  autoplot(resampling, task, fold_id = c(1, 2)) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingSpCVBlock

Visualization Functions for SpCV Block Methods.

Description

Generic S3 plot() and autoplot() (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSpCVBlock'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  show_blocks = FALSE,
  show_labels = FALSE,
  sample_fold_n = NULL,
  label_size = 2,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVBlock'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  show_blocks = FALSE,
  show_labels = FALSE,
  sample_fold_n = NULL,
  label_size = 2,
  ...
)

## S3 method for class 'ResamplingSpCVBlock'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVBlock'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVBlock or ResamplingRepeatedSpCVBlock.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)]

	Should a gridded plot using via **patchwork** be created? If `FALSE` a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument `fold_id`.
`train_color`	`[character(1)]` The color to use for the training set observations.
`test_color`	`[character(1)]` The color to use for the test set observations.
`show_blocks`	`[logical(1)]` Whether to show an overlay of the spatial blocks polygons.
`show_labels`	`[logical(1)]` Whether to show an overlay of the spatial block IDs.
`sample_fold_n`	`[integer]` Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
`label_size`	`[numeric(1)]` Label size of block labels. Only applies for `show_labels = TRUE`.
`...`	Passed to `geom_sf()`. Helpful for adjusting point sizes and shapes.
`repeats_id`	`[numeric]` Repetition ID to plot.
`x`	`[Resampling]` mlr3 spatial resampling object. One of class ResamplingSpCVBuffer, ResamplingSpCVBlock, ResamplingSpCVCoords, ResamplingSpCVEnv.

Details

By default a plot is returned; if `fold_id` is set, a gridded plot is created. If `plot_as_grid = FALSE`, a list of plot objects is returned. This can be used to align the plots individually.

When no single fold is selected, the `ggsci::scale_color_ucscgb()` palette is used to display all partitions. If you want to change the colors, call `<plot> + <color-palette>()`.

Value

`ggplot2::ggplot()` or list of ggplot2 objects.

See Also

- mlr3book chapter on "Spatial Analysis"
- `autoplot.ResamplingSpCVBuffer()`
- `autoplot.ResamplingSpCVCoords()`
- `autoplot.ResamplingSpCVEnv()`
- `autoplot.ResamplingSpCVDisc()`
- `autoplot.ResamplingSpCVTiles()`
- `autoplot.ResamplingCV()`
- `autoplot.ResamplingSptCVCstf()`

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_block", range = 1000L)
  resampling$instantiate(task)

  ## list of ggplot2 resamplings
  plot_list = autoplot(resampling, task,
    crs = 4326,
    fold_id = c(1, 2), plot_as_grid = FALSE)

  ## Visualize all partitions
  autoplot(resampling, task) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))

  ## Visualize the train/test split of a single fold
  autoplot(resampling, task, fold_id = 1) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))

  ## Visualize train/test splits of multiple folds
  autoplot(resampling, task,
    fold_id = c(1, 2),
    show_blocks = TRUE) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingSpCVBuffer

Visualization Functions for SpCV Buffer Methods.

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSpCVBuffer'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  show_omitted = FALSE,
```

```
  ...
)

## S3 method for class 'ResamplingSpCVBuffer'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVBuffer.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)] The color to use for the training set observations.
test_color	[character(1)] The color to use for the test set observations.
show_omitted	[logical] Whether to show points not used in train or test set for the current fold.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
x	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVBuffer.

See Also

- mlr3book chapter on "Spatial Analysis"
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingCV()
- autoplot.ResamplingSptCVCstf()

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_buffer", theRange = 1000)
  resampling$instantiate(task)

  ## single fold
```

```
  autoplot(resampling, task, fold_id = 1) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))

  ## multiple folds
  autoplot(resampling, task, fold_id = c(1, 2)) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

`autoplot.ResamplingSpCVCoords` *Visualization Functions for SpCV Coords Methods.*

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods.

Usage

```
## S3 method for class 'ResamplingSpCVCoords'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVCoords'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingSpCVCoords'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVCoords'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVCoords or ResamplingRepeatedSpCVCoords.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)] The color to use for the training set observations.
test_color	[character(1)] The color to use for the test set observations.
sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
repeats_id	[numeric] Repetition ID to plot.
x	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVCoords or ResamplingRepeatedSpCVCoords.

See Also

- mlr3book chapter on "Spatial Analysis"
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingSpCVDisc()
- autoplot.ResamplingSpCVTiles()
- autoplot.ResamplingCV()
- autoplot.ResamplingSptCVCstf()

Examples

```
if (mlr3misc::require_namespaces(c("sf"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_coords")
```

```
  resampling$instantiate(task)

  autoplot(resampling, task) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
  autoplot(resampling, task, fold_id = 1)
  autoplot(resampling, task, fold_id = c(1, 2)) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

`autoplot.ResamplingSpCVDisc` *Visualization Functions for SpCV Disc Method.*

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSpCVDisc'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  repeats_id = NULL,
  show_omitted = FALSE,
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVDisc'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  show_omitted = FALSE,
  sample_fold_n = NULL,
  ...
)
```

```
## S3 method for class 'ResamplingSpCVDisc'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVDisc'
plot(x, ...)
```

Arguments

`object`	`[Resampling]` mlr3 spatial resampling object of class ResamplingSpCVBlock or ResamplingRepeatedSpCVBlock.
`task`	`[TaskClassifST]/[TaskRegrST]` mlr3 task object.
`fold_id`	`[numeric]` Fold IDs to plot.
`plot_as_grid`	`[logical(1)]` Should a gridded plot using via **patchwork** be created? If `FALSE` a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument `fold_id`.
`train_color`	`[character(1)]` The color to use for the training set observations.
`test_color`	`[character(1)]` The color to use for the test set observations.
`repeats_id`	`[numeric]` Repetition ID to plot.
`show_omitted`	`[logical]` Whether to show points not used in train or test set for the current fold.
`sample_fold_n`	`[integer]` Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
`...`	Passed to `geom_sf()`. Helpful for adjusting point sizes and shapes.
`x`	`[Resampling]` mlr3 spatial resampling object. One of class ResamplingSpCVBuffer, ResamplingSpCVBlock, ResamplingSpCVCoords, ResamplingSpCVEnv.

Details

This method requires to set argument `fold_id` and no plot containing all partitions can be created. This is because the method does not make use of all observations but only a subset of them (many observations are left out). Hence, train and test sets of one fold are not re-used in other folds as in other methods and plotting these without a train/test indicator would not make sense.

2D vs 3D plotting

This method has both a 2D and a 3D plotting method. The 2D method returns a **ggplot** with x and y axes representing the spatial coordinates. The 3D method uses **plotly** to create an interactive 3D

plot. Set `plot3D = TRUE` to use the 3D method.

Note that spatiotemporal datasets usually suffer from overplotting in 2D mode.

See Also

- mlr3book chapter on "Spatial Analysis"
- Vignette Spatiotemporal Visualization.
- `autoplot.ResamplingSpCVBlock()`
- `autoplot.ResamplingSpCVBuffer()`
- `autoplot.ResamplingSpCVCoords()`
- `autoplot.ResamplingSpCVTiles()`
- `autoplot.ResamplingSpCVEnv()`
- `autoplot.ResamplingCV()`

Examples

```
if (mlr3misc::require_namespaces("sf", quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_disc",
    folds = 5, radius = 200L, buffer = 200L)
  resampling$instantiate(task)

  autoplot(resampling, task,
    fold_id = 1,
    show_omitted = TRUE, size = 0.7) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingSpCVEnv

Visualization Functions for SpCV Env Methods.

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods.

Usage

```
## S3 method for class 'ResamplingSpCVEnv'
autoplot(
  object,
  task,
  fold_id = NULL,
```

```
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVEnv'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingSpCVEnv'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVEnv'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVEnv or ResamplingRepeatedSpCVEnv.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)] The color to use for the training set observations.
test_color	[character(1)] The color to use for the test set observations.
sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.

repeats_id [numeric]
Repetition ID to plot.

x [Resampling]
mlr3 spatial resampling object of class ResamplingSpCVEnv or ResamplingRepeatedSpCVEnv.

See Also

- mlr3book chapter on "Spatial Analysis"
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVDisc()
- autoplot.ResamplingSpCVTiles()
- autoplot.ResamplingCV()
- autoplot.ResamplingSptCVCstf()

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_env", folds = 4, features = "dem")
  resampling$instantiate(task)

  autoplot(resampling, task) +
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
  autoplot(resampling, task, fold_id = 1)
  autoplot(resampling, task, fold_id = c(1, 2)) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingSpCVKnndm

Visualization Functions for SpCV knndm Method.

Description

Generic S3 plot() and autoplot() (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSpCVKnndm'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  repeats_id = NULL,
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVKnndm'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingSpCVKnndm'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVKnndm'
plot(x, ...)
```

Arguments

`object`	`[Resampling]` mlr3 spatial resampling object of class ResamplingSpCVBlock or ResamplingRepeatedSpCVBlock.
`task`	`[TaskClassifST]/[TaskRegrST]` mlr3 task object.
`fold_id`	`[numeric]` Fold IDs to plot.
`plot_as_grid`	`[logical(1)]` Should a gridded plot using via **patchwork** be created? If `FALSE` a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument `fold_id`.
`train_color`	`[character(1)]` The color to use for the training set observations.

test_color	[character(1)] The color to use for the test set observations.
repeats_id	[numeric] Repetition ID to plot.
sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
x	[Resampling] mlr3 spatial resampling object. One of class ResamplingSpCVBuffer, ResamplingSpCVBlock, ResamplingSpCVCoords, ResamplingSpCVEnv.

Details

This method requires to set argument fold_id and no plot containing all partitions can be created. This is because the method does not make use of all observations but only a subset of them (many observations are left out). Hence, train and test sets of one fold are not re-used in other folds as in other methods and plotting these without a train/test indicator would not make sense.

2D vs 3D plotting

This method has both a 2D and a 3D plotting method. The 2D method returns a **ggplot** with x and y axes representing the spatial coordinates. The 3D method uses **plotly** to create an interactive 3D plot. Set plot3D = TRUE to use the 3D method.

Note that spatiotemporal datasets usually suffer from overplotting in 2D mode.

See Also

- mlr3book chapter on "Spatial Analysis"
- Vignette Spatiotemporal Visualization.
- autoplot.ResamplingSpCVBlock()
- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVTiles()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingCV()

Examples

```
if (mlr3misc::require_namespaces(c("CAST", "sf"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  points = sf::st_as_sf(task$coordinates(), crs = task$crs, coords = c("x", "y"))
  modeldomain = sf::st_as_sfc(sf::st_bbox(points))
```

```
  resampling = rsmp("spcv_knndm",
    folds = 5, modeldomain = modeldomain)
  resampling$instantiate(task)

  autoplot(resampling, task,
    fold_id = 1, size = 0.7) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

`autoplot.ResamplingSpCVTiles` *Visualization Functions for SpCV Tiles Method.*

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSpCVTiles'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  repeats_id = NULL,
  show_omitted = FALSE,
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSpCVTiles'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  show_omitted = FALSE,
  sample_fold_n = NULL,
  ...
)
```

```
## S3 method for class 'ResamplingSpCVTiles'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSpCVTiles'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSpCVBlock or ResamplingRepeatedSpCVBlock.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)] The color to use for the training set observations.
test_color	[character(1)] The color to use for the test set observations.
repeats_id	[numeric] Repetition ID to plot.
show_omitted	[logical] Whether to show points not used in train or test set for the current fold.
sample_fold_n	[integer] Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.
...	Passed to geom_sf(). Helpful for adjusting point sizes and shapes.
x	[Resampling] mlr3 spatial resampling object. One of class ResamplingSpCVBuffer, ResamplingSpCVBlock, ResamplingSpCVCoords, ResamplingSpCVEnv.

Details

Specific combinations of arguments of "spcv_tiles" remove some observations, hence show_omitted has an effect in some cases.

See Also

- mlr3book chapter on "Spatial Analysis"
- Vignette Spatiotemporal Visualization.
- autoplot.ResamplingSpCVBlock()

- autoplot.ResamplingSpCVBuffer()
- autoplot.ResamplingSpCVCoords()
- autoplot.ResamplingSpCVDisc()
- autoplot.ResamplingSpCVEnv()
- autoplot.ResamplingCV()

Examples

```
if (mlr3misc::require_namespaces(c("sf", "sperrorest"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task = tsk("ecuador")
  resampling = rsmp("spcv_tiles",
    nsplit = c(4L, 3L), reassign = FALSE)
  resampling$instantiate(task)

  autoplot(resampling, task,
    fold_id = 1,
    show_omitted = TRUE, size = 0.7) *
    ggplot2::scale_x_continuous(breaks = seq(-79.085, -79.055, 0.01))
}
```

---

autoplot.ResamplingSptCVCstf

Visualization Functions for SptCV Cstf Methods.

Description

Generic S3 `plot()` and `autoplot()` (ggplot2) methods to visualize mlr3 spatiotemporal resampling objects.

Usage

```
## S3 method for class 'ResamplingSptCVCstf'
autoplot(
  object,
  task,
  fold_id = NULL,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  repeats_id = NULL,
  tickformat_date = "%Y-%m",
  nticks_x = 3,
  nticks_y = 3,
  point_size = 3,
```

```
  axis_label_fontsize = 11,
  static_image = FALSE,
  show_omitted = FALSE,
  plot3D = NULL,
  plot_time_var = NULL,
  sample_fold_n = NULL,
  ...
)

## S3 method for class 'ResamplingRepeatedSptCVCstf'
autoplot(
  object,
  task,
  fold_id = NULL,
  repeats_id = 1,
  plot_as_grid = TRUE,
  train_color = "#0072B5",
  test_color = "#E18727",
  tickformat_date = "%Y-%m",
  nticks_x = 3,
  nticks_y = 3,
  point_size = 3,
  axis_label_fontsize = 11,
  plot3D = NULL,
  plot_time_var = NULL,
  ...
)

## S3 method for class 'ResamplingSptCVCstf'
plot(x, ...)

## S3 method for class 'ResamplingRepeatedSptCVCstf'
plot(x, ...)
```

Arguments

object	[Resampling] mlr3 spatial resampling object of class ResamplingSptCVCstf or ResamplingRepeatedSptCVCstf.
task	[TaskClassifST]/[TaskRegrST] mlr3 task object.
fold_id	[numeric] Fold IDs to plot.
plot_as_grid	[logical(1)] Should a gridded plot using via **patchwork** be created? If FALSE a list with of **ggplot2** objects is returned. Only applies if a numeric vector is passed to argument fold_id.
train_color	[character(1)]

The color to use for the training set observations.

`test_color` [character(1)]
The color to use for the test set observations.

`repeats_id` [numeric]
Repetition ID to plot.

`tickformat_date` [character]
Date format for z-axis.

`nticks_x` [integer]
Number of x axis breaks.

`nticks_y` [integer]
Number of y axis breaks.

`point_size` [numeric]
Point size of markers.

`axis_label_fontsize` [integer]
Font size of axis labels.

`static_image` [logical]
Whether to create a static image from the plotly plot via `plotly::orca()`. This requires the `orca` utility to be available. See https://github.com/plotly/orca for more information. When used, by default a file named `plot.png` is created in the current working directory.

`show_omitted` [logical]
Whether to show points not used in train or test set for the current fold.

`plot3D` [logical]
Whether to create a 2D image via **ggplot2** or a 3D plot via **plotly**.

`plot_time_var` [character]
The variable to use for the z-axis (time). Remove the column role `feature` for this variable to only use it for plotting.

`sample_fold_n` [integer]
Number of points in a random sample stratified over partitions. This argument aims to keep file sizes of resulting plots reasonable and reduce overplotting in dense datasets.

`...` Passed down to `plotly::orca()`. Only effective when `static_image = TRUE`.

`x` [Resampling]
mlr3 spatial resampling object of class ResamplingSptCVCstf or ResamplingRepeatedSptCVCstf.

Details

This method requires to set argument `fold_id`. No plot showing all folds in one plot can be created. This is because the LLTO method does not make use of all observations but only a subset of them (many observations are omitted). Hence, train and test sets of one fold are not re-used in other folds as in other methods and plotting these without a train/test indicator would be misleading.

2D vs 3D plotting

This method has both a 2D and a 3D plotting method. The 2D method returns a **ggplot** with x and y axes representing the spatial coordinates. The 3D method uses **plotly** to create an interactive 3D plot. Set `plot3D = TRUE` to use the 3D method.

Note that spatiotemporal datasets usually suffer from overplotting in 2D mode.

See Also

- mlr3book chapter on "Spatiotemporal Visualization"
- Vignette Spatiotemporal Visualization.
- `autoplot.ResamplingSpCVBlock()`
- `autoplot.ResamplingSpCVBuffer()`
- `autoplot.ResamplingSpCVCoords()`
- `autoplot.ResamplingSpCVEnv()`
- `autoplot.ResamplingCV()`

Examples

```
if (mlr3misc::require_namespaces(c("sf", "plotly"), quietly = TRUE)) {
  library(mlr3)
  library(mlr3spatiotempcv)
  task_st = tsk("cookfarm_mlr3")
  task_st$set_col_roles("SOURCEID", "space")
  task_st$set_col_roles("Date", "time")
  resampling = rsmp("sptcv_cstf", folds = 5)
  resampling$instantiate(task_st)

  # with both `"space"` and `"time"` column roles set (LLTO), the omitted
  # observations per fold can be shown by setting `show_omitted = TRUE`
  autoplot(resampling, task_st, fold_id = 1, show_omitted = TRUE)
}
```

---

mlr_resamplings_repeated_spcv_block

(blockCV) Repeated spatial block resampling

Description

This function creates spatially separated folds based on a distance to number of row and/or column. It assigns blocks to the training and testing folds **randomly**, **systematically** or in a **checkerboard pattern**. The distance (`size`) should be in **metres**, regardless of the unit of the reference system of the input data (for more information see the details section). By default, the function creates blocks according to the extent and shape of the spatial sample data (`x` e.g. the species occurrence), Alternatively, blocks can be created based on `r` assuming that the user has considered the landscape

for the given species and case study. Blocks can also be offset so the origin is not at the outer corner of the rasters. Instead of providing a distance, the blocks can also be created by specifying a number of rows and/or columns and divide the study area into vertical or horizontal bins, as presented in Wenger & Olden (2012) and Bahn & McGill (2012). Finally, the blocks can be specified by a user-defined spatial polygon layer.

Details

To maintain consistency, all functions in this package use **meters** as their unit of measurement. However, when the input map has a geographic coordinate system (in decimal degrees), the block size is calculated by dividing the `size` parameter by `deg_to_metre` (which defaults to 111325 meters, the standard distance of one degree of latitude on the Equator). In reality, this value varies by a factor of the cosine of the latitude. So, an alternative sensible value could be `cos(mean(sf::st_bbox(x)[c(2,4)]) * pi/180) * 111325`.

The `offset` can be used to change the spatial position of the blocks. It can also be used to assess the sensitivity of analysis results to shifting in the blocking arrangements. These options are available when `size` is defined. By default the region is located in the middle of the blocks and by setting the offsets, the blocks will shift.

Roberts et. al. (2017) suggest that blocks should be substantially bigger than the range of spatial autocorrelation (in model residual) to obtain realistic error estimates, while a buffer with the size of the spatial autocorrelation range would result in a good estimation of error. This is because of the so-called edge effect (O'Sullivan & Unwin, 2014), whereby points located on the edges of the blocks of opposite sets are not separated spatially. Blocking with a buffering strategy overcomes this issue (see `cv_buffer`).

mlr3spatiotempcv notes

By default `blockCV::cv_spatial()` does not allow the creation of multiple repetitions. `mlr3spatiotempcv` adds support for this when using the `size` argument for fold creation. When supplying a vector of `length(repeats)` for argument `size`, these different settings will be used to create folds which differ among the repetitions.

Multiple repetitions are not possible when using the "row & cols" approach because the created folds will always be the same.

The 'Description' and 'Details' fields are inherited from the respective upstream function.

For a list of available arguments, please see blockCV::cv_spatial.

`blockCV` >= 3.0.0 changed the argument names of the implementation. For backward compatibility, `mlr3spatiotempcv` is still using the old ones. Here's a list which shows the mapping between `blockCV` < 3.0.0 and `blockCV` >= 3.0.0:

- `range` -> `size`
- `rasterLayer` -> `r`
- `speciesData` -> `points`
- `showBlocks` -> `plot`
- `cols` and `rows` -> `rows_cols`

The default of argument `hexagon` is different in `mlr3spatiotempcv` (`FALSE` instead of `TRUE`) to create square blocks instead of hexagonal blocks by default.

Parameters

- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVBlock`

Public fields

`blocks sf | list of sf objects`
Polygons (`sf` objects) as returned by **blockCV** which grouped observations into partitions.

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVBlock$new()`
- `ResamplingRepeatedSpCVBlock$folds()`
- `ResamplingRepeatedSpCVBlock$repeats()`
- `ResamplingRepeatedSpCVBlock$instantiate()`
- `ResamplingRepeatedSpCVBlock$clone()`

Method `new()`**:** Create an "spatial block" repeated resampling instance.
For a list of available arguments, please see blockCV::cv_spatial.

Usage:

```
ResamplingRepeatedSpCVBlock$new(id = "repeated_spcv_block")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVBlock$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVBlock$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVBlock$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

Examples

```
## Not run:
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  task = tsk("diplodia")

  # Instantiate Resampling
  rrcv = rsmp("repeated_spcv_block",
    folds = 3, repeats = 2,
    range = c(5000L, 10000L))
  rrcv$instantiate(task)

  # Individual sets:
  rrcv$iters
  rrcv$folds(1:6)
  rrcv$repeats(1:6)

  # Individual sets:
  rrcv$train_set(1)
  rrcv$test_set(1)
  intersect(rrcv$train_set(1), rrcv$test_set(1))

  # Internal storage:
  rrcv$instance # table
}
```

```
## End(Not run)
```

`mlr_resamplings_repeated_spcv_coords` *(sperrorest) Repeated coordinate-based k-means clustering*

Description

Splits data by clustering in the coordinate space. See the upstream implementation at `sperrorest::partition_kmeans()` and Brenning (2012) for further information.

Details

Universal partitioning method that splits the data in the coordinate space. Useful for spatially homogeneous datasets that cannot be split well with rectangular approaches like `ResamplingSpCVBlock`.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVCoords`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVCoords$new()`
- `ResamplingRepeatedSpCVCoords$folds()`
- `ResamplingRepeatedSpCVCoords$repeats()`
- `ResamplingRepeatedSpCVCoords$instantiate()`
- `ResamplingRepeatedSpCVCoords$clone()`

Method `new()`**:** Create an "coordinate-based" repeated resampling instance.
For a list of available arguments, please see sperrorest::partition_cv.

Usage:

```
ResamplingRepeatedSpCVCoords$new(id = "repeated_spcv_coords")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVCoords$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVCoords$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVCoords$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

Examples

```
library(mlr3)
task = tsk("diplodia")

# Instantiate Resampling
rrcv = rsmp("repeated_spcv_coords", folds = 3, repeats = 5)
rrcv$instantiate(task)
```

```
# Individual sets:
rrcv$iters
rrcv$folds(1:6)
rrcv$repeats(1:6)

# Individual sets:
rrcv$train_set(1)
rrcv$test_set(1)
intersect(rrcv$train_set(1), rrcv$test_set(1))

# Internal storage:
rrcv$instance # table
```

`mlr_resamplings_repeated_spcv_disc`
(sperrorest) Repeated spatial "disc" resampling

Description

(sperrorest) Repeated spatial "disc" resampling

(sperrorest) Repeated spatial "disc" resampling

Parameters

- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVDisc`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVDisc$new()`
- `ResamplingRepeatedSpCVDisc$folds()`
- `ResamplingRepeatedSpCVDisc$repeats()`
- `ResamplingRepeatedSpCVDisc$instantiate()`
- `ResamplingRepeatedSpCVDisc$clone()`

Method `new()`**:** Create a "Spatial 'Disc' resampling" resampling instance.
For a list of available arguments, please see sperrorest::partition_disc.

Usage:

```
ResamplingRepeatedSpCVDisc$new(id = "repeated_spcv_disc")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVDisc$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVDisc$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVDisc$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

Examples

```
library(mlr3)
task = tsk("ecuador")

# Instantiate Resampling
rrcv = rsmp("repeated_spcv_disc",
  folds = 3L, repeats = 2,
  radius = 200L, buffer = 200L)
rrcv$instantiate(task)

# Individual sets:
rrcv$iters
rrcv$folds(1:6)
rrcv$repeats(1:6)

# Individual sets:
rrcv$train_set(1)
rrcv$test_set(1)
intersect(rrcv$train_set(1), rrcv$test_set(1))

# Internal storage:
rrcv$instance # table
```

`mlr_resamplings_repeated_spcv_env`
(blockCV) Repeated "environmental blocking" resampling

Description

Splits data by clustering in the feature space. See the upstream implementation at `blockCV::cv_cluster()` and Valavi et al. (2018) for further information.

Details

Useful when the dataset is supposed to be split on environmental information which is present in features. The method allows for a combination of multiple features for clustering.

The input of raster images directly as in `blockCV::cv_cluster()` is not supported. See **mlr3spatial** and its raster DataBackends for such support in **mlr3**.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `features` (`character()`)
  The features to use for clustering.
- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVEnv`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVEnv$new()`
- `ResamplingRepeatedSpCVEnv$folds()`
- `ResamplingRepeatedSpCVEnv$repeats()`
- `ResamplingRepeatedSpCVEnv$instantiate()`
- `ResamplingRepeatedSpCVEnv$clone()`

Method `new()`**:** Create an "Environmental Block" repeated resampling instance.
For a list of available arguments, please see blockCV::cv_cluster.

Usage:

```
ResamplingRepeatedSpCVEnv$new(id = "repeated_spcv_env")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVEnv$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVEnv$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVEnv$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rrcv = rsmp("repeated_spcv_env", folds = 4, repeats = 2)
  rrcv$instantiate(task)

  # Individual sets:
  rrcv$train_set(1)
  rrcv$test_set(1)
  intersect(rrcv$train_set(1), rrcv$test_set(1))

  # Internal storage:
  rrcv$instance
}
```

---

mlr_resamplings_repeated_spcv_knndm

(CAST) Repeated K-fold Nearest Neighbour Distance Matching

Description

This function implements the kNNDM algorithm and returns the necessary indices to perform a k-fold NNDM CV for map validation.

Details

knndm is a k-fold version of NNDM LOO CV for medium and large datasets. Brielfy, the algorithm tries to find a k-fold configuration such that the integral of the absolute differences (Wasserstein W statistic) between the empirical nearest neighbour distance distribution function between the test and training data during CV (Gj*), and the empirical nearest neighbour distance distribution function between the prediction and training points (Gij), is minimised. It does so by performing clustering of the training points' coordinates for different numbers of clusters that range from k to N (number of observations), merging them into k final folds, and selecting the configuration with the lowest W.

Using a projected CRS in 'knndm' has large computational advantages since fast nearest neighbour search can be done via the 'FNN' package, while working with geographic coordinates requires computing the full spherical distance matrices. As a clustering algorithm, 'kmeans' can only be used for projected CRS while 'hierarchical' can work with both projected and geographical coordinates, though it requires calculating the full distance matrix of the training points even for a projected CRS.

In order to select between clustering algorithms and number of folds 'k', different 'knndm' configurations can be run and compared, being the one with a lower W statistic the one that offers a better match. W statistics between 'knndm' runs are comparable as long as 'tpoints' and 'predpoints' or 'modeldomain' stay the same.

Map validation using 'knndm' should be used using 'CAST::global_validation', i.e. by stacking all out-of-sample predictions and evaluating them all at once. The reasons behind this are 1) The resulting folds can be unbalanced and 2) nearest neighbour functions are constructed and matched using all CV folds simultaneously.

If training data points are very clustered with respect to the prediction area and the presented 'knndm' configuration still show signs of Gj* > Gij, there are several things that can be tried. First, increase the 'maxp' parameter; this may help to control for strong clustering (at the cost of having unbalanced folds). Secondly, decrease the number of final folds 'k', which may help to have larger clusters.

The 'modeldomain' is either a sf polygon that defines the prediction area, or alternatively a SpatRaster out of which a polygon, transformed into the CRS of the training points, is defined as the outline of all non-NA cells. Then, the function takes a regular point sample (amount defined by 'samplesize') from the spatial extent. As an alternative use 'predpoints' instead of 'modeldomain', if you have already defined the prediction locations (e.g. raster pixel centroids). When using either 'modeldomain' or 'predpoints', we advise to plot the study area polygon and the training/prediction points as a previous step to ensure they are aligned.

'knndm' can also be performed in the feature space by setting 'space' to "feature". Euclidean distances or Mahalanobis distances can be used for distance calculation, but only Euclidean are tested. In this case, nearest neighbour distances are calculated in n-dimensional feature space rather than in geographical space. 'tpoints' and 'predpoints' can be data frames or sf objects containing the values of the features. Note that the names of 'tpoints' and 'predpoints' must be the same. 'predpoints' can also be missing, if 'modeldomain' is of class SpatRaster. In this case, the values of of the SpatRaster will be extracted to the 'predpoints'. In the case of any categorical features, Gower distances will be used to calculate the Nearest Neighbour distances [Experimental]. If categorical features are present, and 'clustering' = "kmeans", K-Prototype clustering will be performed instead.

Parameters

- `folds` (`integer(1)`)

Number of folds.

- `stratify`
  If `TRUE`, stratify on the target column.

- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVKnndm`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVKnndm$new()`
- `ResamplingRepeatedSpCVKnndm$folds()`
- `ResamplingRepeatedSpCVKnndm$repeats()`
- `ResamplingRepeatedSpCVKnndm$instantiate()`
- `ResamplingRepeatedSpCVKnndm$clone()`

Method `new()`**:** Create a "K-fold Nearest Neighbour Distance Matching" resampling instance.

Usage:

```
ResamplingRepeatedSpCVKnndm$new(id = "repeated_spcv_knndm")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVKnndm$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVKnndm$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVKnndm$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Linnenbrink, J., Mila, C., Ludwig, M., Meyer, H. (2023). "kNNDM: k-fold Nearest Neighbour Distance Matching Cross-Validation for map accuracy estimation." *EGUsphere*, **2023**, 1–16. doi:10.5194/egusphere20231308, https://egusphere.copernicus.org/preprints/2023/egusphere-2023-1308/.

Examples

```
if (requireNamespace(c("mlr3spatial", "mlr3"))) {
  library(mlr3)
  library(mlr3spatial)
  set.seed(42)
  simarea = list(matrix(c(0, 0, 0, 100, 100, 100, 100, 0, 0, 0), ncol = 2, byrow = TRUE))
  simarea = sf::st_polygon(simarea)
  train_points = sf::st_sample(simarea, 1000, type = "random")
  train_points = sf::st_as_sf(train_points)
  train_points$target = as.factor(sample(c("TRUE", "FALSE"), 1000, replace = TRUE))
  pred_points = sf::st_sample(simarea, 1000, type = "regular")

 task = mlr3spatial::as_task_classif_st(sf::st_as_sf(train_points), "target", positive = "TRUE")

  cv_knndm = rsmp("repeated_spcv_knndm", predpoints = pred_points, repeats = 2)
  cv_knndm$instantiate(task)
  ### Individual sets:
  # cv_knndm$train_set(1)
  # cv_knndm$test_set(1)
  # check that no obs are in both sets
  intersect(cv_knndm$train_set(1), cv_knndm$test_set(1)) # good!

  # Internal storage:
  # cv_knndm$instance # table
}
```

`mlr_resamplings_repeated_spcv_tiles`
(sperrorest) Repeated spatial "tiles" resampling

Description

Spatial partitioning using rectangular tiles. Small partitions can optionally be merged into adjacent ones to avoid partitions with too few observations. This method is similar to `ResamplingSpCVBlock` by making use of rectangular zones in the coordinate space. See the upstream implementation at `sperrorest::partition_disc()` and Brenning (2012) for further information.

Parameters

- `dsplit` (`integer(2)`)
  Equidistance of splits in (possibly rotated) x direction (`dsplit[1]`) and y direction (`dsplit[2]`) used to define tiles. If dsplit is of length 1, its value is recycled. Either `dsplit` or `nsplit` must be specified.
- `nsplit` (`integer(2)`)
  Number of splits in (possibly rotated) x direction (`nsplit[1]`) and y direction (`nsplit[2]`) used to define tiles. If `nsplit` is of length 1, its value is recycled.
- `rotation` (`character(1)`)
  Whether and how the rectangular grid should be rotated; random rotation is only possible between -45 and +45 degrees. Accepted values: One of `c("none", "random", "user")`.
- `user_rotation` (`character(1)`)
  Only used when `rotation = "user"`. Angle(s) (in degrees) by which the rectangular grid is to be rotated in each repetition. Either a vector of same length as `repeats`, or a single number that will be replicated `length(repeats)` times.
- `offset` (`logical(1)`)
  Whether and how the rectangular grid should be shifted by an offset. Accepted values: One of `c("none", "random", "user")`.
- `user_offset` (`logical(1)`)
  Only used when `offset = "user"`. A list (or vector) of two components specifying a shift of the rectangular grid in (possibly rotated) x and y direction. The offset values are relative values, a value of 0.5 resulting in a one-half tile shift towards the left, or upward. If this is a list, its first (second) component refers to the rotated x (y) direction, and both components must have same length as `repeats` (or length 1). If a vector of length 2 (or list components have length 1), the two values will be interpreted as relative shifts in (rotated) x and y direction, respectively, and will therefore be recycled as needed (`length(repeats)` times each).
- `reassign` (`logical(1)`)
  If `TRUE`, 'small' tiles (as per `min_frac` and `min_n`) are merged with (smallest) adjacent tiles. If `FALSE`, small tiles are 'eliminated', i.e., set to `NA`.
- `min_frac` (`numeric(1)`)
  Value must be >=0, <1. Minimum relative size of partition as percentage of sample.
- `min_n` (`integer(1)`)
  Minimum number of samples per partition.

- `iterate` (`integer(1)`)
  Passed down to `sperrorest::tile_neighbors()`.

- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSpCVTiles`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSpCVTiles$new()`
- `ResamplingRepeatedSpCVTiles$folds()`
- `ResamplingRepeatedSpCVTiles$repeats()`
- `ResamplingRepeatedSpCVTiles$instantiate()`
- `ResamplingRepeatedSpCVTiles$clone()`

Method `new()`**:** Create a "Spatial 'Tiles' resampling" resampling instance.
For a list of available arguments, please see sperrorest::partition_tiles.

Usage:

```
ResamplingRepeatedSpCVTiles$new(id = "repeated_spcv_tiles")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSpCVTiles$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSpCVTiles$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSpCVTiles$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

See Also

ResamplingSpCVBlock

Examples

```
if (mlr3misc::require_namespaces("sperrorest", quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rrcv = rsmp("repeated_spcv_tiles",
    repeats = 2,
    nsplit = c(4L, 3L), reassign = FALSE)
  rrcv$instantiate(task)

  # Individual sets:
  rrcv$iters
  rrcv$folds(10:12)
  rrcv$repeats(10:12)

  # Individual sets:
  rrcv$train_set(1)
  rrcv$test_set(1)
  intersect(rrcv$train_set(1), rrcv$test_set(1))

  # Internal storage:
  rrcv$instance # table
}
```

`mlr_resamplings_repeated_sptcv_cstf` *(CAST) Repeated spatiotemporal "leave-location-and-time-out" resampling*

Description

Splits data using Leave-Location-Out (LLO), Leave-Time-Out (LTO) and Leave-Location-and-Time-Out (LLTO) partitioning. See the upstream implementation at `CreateSpacetimeFolds()` (package **CAST**) and Meyer et al. (2018) for further information.

Details

LLO predicts on unknown locations i.e. complete locations are left out in the training sets. The `"space"` role in `Task$col_roles` identifies spatial units. If `stratify` is `TRUE`, the target distribution is similar in each fold. This is useful for land cover classification when the observations are polygons. In this case, LLO with stratification should be used to hold back complete polygons and have a similar target distribution in each fold. LTO leaves out complete temporal units which are identified by the `"time"` role in `Task$col_roles`. LLTO leaves out spatial and temporal units. See the examples.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `stratify`
  If `TRUE`, stratify on the target column.
- `repeats` (`integer(1)`)
  Number of repeats.

Super class

`mlr3::Resampling` -> `ResamplingRepeatedSptCVCstf`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingRepeatedSptCVCstf$new()`
- `ResamplingRepeatedSptCVCstf$folds()`
- `ResamplingRepeatedSptCVCstf$repeats()`
- `ResamplingRepeatedSptCVCstf$instantiate()`

- `ResamplingRepeatedSptCVCstf$clone()`

Method `new()`**:** Create a "Spacetime Folds" resampling instance.

Usage:

```
ResamplingRepeatedSptCVCstf$new(id = "repeated_sptcv_cstf")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `folds()`**:** Translates iteration numbers to fold number.

Usage:

```
ResamplingRepeatedSptCVCstf$folds(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `repeats()`**:** Translates iteration numbers to repetition number.

Usage:

```
ResamplingRepeatedSptCVCstf$repeats(iters)
```

Arguments:

`iters integer()`
Iteration number.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingRepeatedSptCVCstf$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Zhao Y, Karypis G (2002). "Evaluation of Hierarchical Clustering Algorithms for Document Datasets." *11th Conference of Information and Knowledge Management (CIKM)*, 51-524. doi:10.1145/584792.584877.

Examples

```
library(mlr3)
task = tsk("cookfarm_mlr3")
task$set_col_roles("SOURCEID", roles = "space")
task$set_col_roles("Date", roles = "time")

# Instantiate Resampling
rcv = rsmp("repeated_sptcv_cstf", folds = 5, repeats = 2)
rcv$instantiate(task)

### Individual sets:
# rcv$train_set(1)
# rcv$test_set(1)
# check that no obs are in both sets
intersect(rcv$train_set(1), rcv$test_set(1)) # good!

# Internal storage:
# rcv$instance # table
```

---

mlr_resamplings_spcv_block

(blockCV) Spatial block resampling

Description

This function creates spatially separated folds based on a distance to number of row and/or column. It assigns blocks to the training and testing folds **randomly**, **systematically** or in a **checkerboard pattern**. The distance (`size`) should be in **metres**, regardless of the unit of the reference system of the input data (for more information see the details section). By default, the function creates blocks according to the extent and shape of the spatial sample data (`x` e.g. the species occurrence), Alternatively, blocks can be created based on `r` assuming that the user has considered the landscape for the given species and case study. Blocks can also be offset so the origin is not at the outer corner of the rasters. Instead of providing a distance, the blocks can also be created by specifying a number of rows and/or columns and divide the study area into vertical or horizontal bins, as presented in Wenger & Olden (2012) and Bahn & McGill (2012). Finally, the blocks can be specified by a user-defined spatial polygon layer.

Details

To maintain consistency, all functions in this package use **meters** as their unit of measurement. However, when the input map has a geographic coordinate system (in decimal degrees), the block size is calculated by dividing the `size` parameter by `deg_to_metre` (which defaults to 111325 meters, the standard distance of one degree of latitude on the Equator). In reality, this value varies by a factor of the cosine of the latitude. So, an alternative sensible value could be `cos(mean(sf::st_bbox(x)[c(2,4)]) * pi/180) * 111325`.

The `offset` can be used to change the spatial position of the blocks. It can also be used to assess the sensitivity of analysis results to shifting in the blocking arrangements. These options are available

when `size` is defined. By default the region is located in the middle of the blocks and by setting the offsets, the blocks will shift.

Roberts et. al. (2017) suggest that blocks should be substantially bigger than the range of spatial autocorrelation (in model residual) to obtain realistic error estimates, while a buffer with the size of the spatial autocorrelation range would result in a good estimation of error. This is because of the so-called edge effect (O'Sullivan & Unwin, 2014), whereby points located on the edges of the blocks of opposite sets are not separated spatially. Blocking with a buffering strategy overcomes this issue (see `cv_buffer`).

mlr3spatiotempcv notes

By default `blockCV::cv_spatial()` does not allow the creation of multiple repetitions. `mlr3spatiotempcv` adds support for this when using the `size` argument for fold creation. When supplying a vector of `length(repeats)` for argument `size`, these different settings will be used to create folds which differ among the repetitions.

Multiple repetitions are not possible when using the "row & cols" approach because the created folds will always be the same.

The 'Description' and 'Details' fields are inherited from the respective upstream function.

For a list of available arguments, please see blockCV::cv_spatial.

`blockCV` >= 3.0.0 changed the argument names of the implementation. For backward compatibility, `mlr3spatiotempcv` is still using the old ones. Here's a list which shows the mapping between `blockCV` < 3.0.0 and `blockCV` >= 3.0.0:

- `range` -> `size`
- `rasterLayer` -> `r`
- `speciesData` -> `points`
- `showBlocks` -> `plot`
- `cols` and `rows` -> `rows_cols`

The default of argument `hexagon` is different in `mlr3spatiotempcv` (`FALSE` instead of `TRUE`) to create square blocks instead of hexagonal blocks by default.

Super class

`mlr3::Resampling` -> `ResamplingSpCVBlock`

Public fields

`blocks sf | list of sf objects`
: Polygons (`sf` objects) as returned by **blockCV** which grouped observations into partitions.

Active bindings

`iters integer(1)`
: Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVBlock$new()`
- `ResamplingSpCVBlock$instantiate()`
- `ResamplingSpCVBlock$clone()`

Method `new()`**:** Create an "spatial block" resampling instance.
For a list of available arguments, please see `blockCV::cv_spatial()`.

Usage:

```
ResamplingSpCVBlock$new(id = "spcv_block")
```

Arguments:

`id` `character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVBlock$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rcv = rsmp("spcv_block", range = 3000L, folds = 3)
  rcv$instantiate(task)

  # Individual sets:
  rcv$train_set(1)
  rcv$test_set(1)
```

```
  intersect(rcv$train_set(1), rcv$test_set(1))

  # Internal storage:
  rcv$instance
}
```

`mlr_resamplings_spcv_buffer` *(blockCV) Spatial buffering resampling*

Description

This function generates spatially separated train and test folds by considering buffers of the specified distance (`size` parameter) around each observation point. This approach is a form of *leave-one-out* cross-validation. Each fold is generated by excluding nearby observations around each testing point within the specified distance (ideally the range of spatial autocorrelation, see `cv_spatial_autocor`). In this method, the testing set never directly abuts a training sample (e.g. presence or absence; 0s and 1s). For more information see the details section.

Details

When working with presence-background (presence and pseudo-absence) species distribution data (should be specified by `presence_bg = TRUE` argument), only presence records are used for specifying the folds (recommended). Consider a target presence point. The buffer is defined around this target point, using the specified range (`size`). By default, the testing fold comprises only the target presence point (all background points within the buffer are also added when `add_bg = TRUE`). Any non-target presence points inside the buffer are excluded. All points (presence and background) outside of buffer are used for the training set. The methods cycles through all the *presence* data, so the number of folds is equal to the number of presence points in the dataset.

For presence-absence data (and all other types of data), folds are created based on all records, both presences and absences. As above, a target observation (presence or absence) forms a test point, all presence and absence points other than the target point within the buffer are ignored, and the training set comprises all presences and absences outside the buffer. Apart from the folds, the number of *training-presence*, *training-absence*, *testing-presence* and *testing-absence* records is stored and returned in the `records` table. If `column = NULL` and `presence_bg = FALSE`, the procedure is like presence-absence data. All other data types (continuous, count or multi-class responses) should be done by `presence_bg = FALSE`.

mlr3spatiotempcv notes

The 'Description' and 'Details' fields are inherited from the respective upstream function. For a list of available arguments, please see blockCV::cv_buffer.

`blockCV` >= 3.0.0 changed the argument names of the implementation. For backward compatibility, `mlr3spatiotempcv` is still using the old ones. Here's a list which shows the mapping between `blockCV` < 3.0.0 and `blockCV` >= 3.0.0:

- theRange -> size
- addBG -> add_bg
- spDataType (character vector) -> presence_bg (boolean)

Super class

mlr3::Resampling -> ResamplingSpCVBuffer

Active bindings

iters integer(1)
Returns the number of resampling iterations, depending on the values stored in the param_set.

Methods

Public methods:

- ResamplingSpCVBuffer$new()
- ResamplingSpCVBuffer$instantiate()
- ResamplingSpCVBuffer$clone()

Method new(): Create an "Environmental Block" resampling instance.
For a list of available arguments, please see blockCV::cv_buffer().

Usage:

```
ResamplingSpCVBuffer$new(id = "spcv_buffer")
```

Arguments:

id character(1)
Identifier for the resampling strategy.

Method instantiate(): Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVBuffer$instantiate(task)
```

Arguments:

task mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

deep Whether to make a deep clone.

References

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

See Also

ResamplingSpCVDisc

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rcv = rsmp("spcv_buffer", theRange = 10000)
  rcv$instantiate(task)

  # Individual sets:
  rcv$train_set(1)
  rcv$test_set(1)
  intersect(rcv$train_set(1), rcv$test_set(1))

  # Internal storage:
  # rcv$instance
}
```

---

mlr_resamplings_spcv_coords

(sperrorest) Coordinate-based k-means clustering

Description

Splits data by clustering in the coordinate space. See the upstream implementation at `sperrorest::partition_kmeans()` and Brenning (2012) for further information.

Details

Universal partitioning method that splits the data in the coordinate space. Useful for spatially homogeneous datasets that cannot be split well with rectangular approaches like `ResamplingSpCVBlock`.

Parameters

- `folds` (`integer(1)`)
  Number of folds.

Super class

`mlr3::Resampling` -> `ResamplingSpCVCoords`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVCoords$new()`
- `ResamplingSpCVCoords$instantiate()`
- `ResamplingSpCVCoords$clone()`

Method `new()`**:** Create an "coordinate-based" repeated resampling instance.
For a list of available arguments, please see sperrorest::partition_cv.

Usage:

```
ResamplingSpCVCoords$new(id = "spcv_coords")
```

Arguments:

`id` `character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVCoords$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

Examples

```
library(mlr3)
task = tsk("ecuador")

# Instantiate Resampling
rcv = rsmp("spcv_coords", folds = 5)
rcv$instantiate(task)

# Individual sets:
rcv$train_set(1)
rcv$test_set(1)
# check that no obs are in both sets
```

```
intersect(rcv$train_set(1), rcv$test_set(1)) # good!

# Internal storage:
rcv$instance # table
```

`mlr_resamplings_spcv_disc`

(sperrorest) Spatial "disc" resampling

Description

Spatial partitioning using circular test areas of one of more observations. Optionally, a buffer around the test area can be used to exclude observations. See the upstream implementation at `sperrorest::partition_disc()` and Brenning (2012) for further information.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `radius` (`numeric(1)`)
  Radius of test area disc.
- `buffer` (`integer(1)`)
  Radius around test area disc which is excluded from training or test set.
- `prob` (`integer(1)`)
  Optional argument passed down to `sample()`.
- `replace` (`logical(1)`)
  Optional argument passed down to `sample()`. Sample with or without replacement.

Super class

`mlr3::Resampling` -> `ResamplingSpCVDisc`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVDisc$new()`
- `ResamplingSpCVDisc$instantiate()`
- `ResamplingSpCVDisc$clone()`

Method `new()`**:** Create a "Spatial 'Disc' resampling" resampling instance.
For a list of available arguments, please see sperrorest::partition_disc.

Usage:

```
ResamplingSpCVDisc$new(id = "spcv_disc")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVDisc$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

Examples

```
library(mlr3)
task = tsk("ecuador")

# Instantiate Resampling
rcv = rsmp("spcv_disc", folds = 3L, radius = 200L, buffer = 200L)
rcv$instantiate(task)

# Individual sets:
rcv$train_set(1)
rcv$test_set(1)
# check that no obs are in both sets
intersect(rcv$train_set(1), rcv$test_set(1)) # good!

# Internal storage:
rcv$instance # table
```

`mlr_resamplings_spcv_env` *(blockCV) "Environmental blocking" resampling*

Description

Splits data by clustering in the feature space. See the upstream implementation at `blockCV::cv_cluster()` and Valavi et al. (2018) for further information.

Details

Useful when the dataset is supposed to be split on environmental information which is present in features. The method allows for a combination of multiple features for clustering.

The input of raster images directly as in `blockCV::cv_cluster()` is not supported. See **mlr3spatial** and its raster DataBackends for such support in **mlr3**.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `features` (`character()`)
  The features to use for clustering.

Super class

`mlr3::Resampling` -> `ResamplingSpCVEnv`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVEnv$new()`
- `ResamplingSpCVEnv$instantiate()`
- `ResamplingSpCVEnv$clone()`

Method `new()`**:** Create an "Environmental Block" resampling instance.

For a list of available arguments, please see blockCV::cv_cluster.

Usage:

```
ResamplingSpCVEnv$new(id = "spcv_env")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVEnv$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Valavi R, Elith J, Lahoz-Monfort JJ, Guillera-Arroita G (2018). "blockCV: an R package for generating spatially or environmentally separated folds for k-fold cross-validation of species distribution models." *bioRxiv*. doi:10.1101/357798.

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rcv = rsmp("spcv_env", folds = 4)
  rcv$instantiate(task)

  # Individual sets:
  rcv$train_set(1)
  rcv$test_set(1)
  intersect(rcv$train_set(1), rcv$test_set(1))

  # Internal storage:
  rcv$instance
}
```

`mlr_resamplings_spcv_knndm` *(CAST) K-fold Nearest Neighbour Distance Matching*

Description

This function implements the kNNDM algorithm and returns the necessary indices to perform a k-fold NNDM CV for map validation.

Details

knndm is a k-fold version of NNDM LOO CV for medium and large datasets. Brielfy, the algorithm tries to find a k-fold configuration such that the integral of the absolute differences (Wasserstein W statistic) between the empirical nearest neighbour distance distribution function between the test and training data during CV (Gj*), and the empirical nearest neighbour distance distribution function between the prediction and training points (Gij), is minimised. It does so by performing clustering of the training points' coordinates for different numbers of clusters that range from k to N (number of observations), merging them into k final folds, and selecting the configuration with the lowest W.

Using a projected CRS in 'knndm' has large computational advantages since fast nearest neighbour search can be done via the 'FNN' package, while working with geographic coordinates requires computing the full spherical distance matrices. As a clustering algorithm, 'kmeans' can only be used for projected CRS while 'hierarchical' can work with both projected and geographical coordinates, though it requires calculating the full distance matrix of the training points even for a projected CRS.

In order to select between clustering algorithms and number of folds 'k', different 'knndm' configurations can be run and compared, being the one with a lower W statistic the one that offers a better match. W statistics between 'knndm' runs are comparable as long as 'tpoints' and 'predpoints' or 'modeldomain' stay the same.

Map validation using 'knndm' should be used using 'CAST::global_validation', i.e. by stacking all out-of-sample predictions and evaluating them all at once. The reasons behind this are 1) The resulting folds can be unbalanced and 2) nearest neighbour functions are constructed and matched using all CV folds simultaneously.

If training data points are very clustered with respect to the prediction area and the presented 'knndm' configuration still show signs of Gj* > Gij, there are several things that can be tried. First, increase the 'maxp' parameter; this may help to control for strong clustering (at the cost of having unbalanced folds). Secondly, decrease the number of final folds 'k', which may help to have larger clusters.

The 'modeldomain' is either a sf polygon that defines the prediction area, or alternatively a SpatRaster out of which a polygon, transformed into the CRS of the training points, is defined as the outline of all non-NA cells. Then, the function takes a regular point sample (amount defined by 'samplesize') from the spatial extent. As an alternative use 'predpoints' instead of 'modeldomain', if you have already defined the prediction locations (e.g. raster pixel centroids). When using either 'modeldomain' or 'predpoints', we advise to plot the study area polygon and the training/prediction points as a previous step to ensure they are aligned.

'knndm' can also be performed in the feature space by setting 'space' to "feature". Euclidean distances or Mahalanobis distances can be used for distance calculation, but only Euclidean are tested. In this case, nearest neighbour distances are calculated in n-dimensional feature space rather than in geographical space. 'tpoints' and 'predpoints' can be data frames or sf objects containing the values of the features. Note that the names of 'tpoints' and 'predpoints' must be the same. 'predpoints' can also be missing, if 'modeldomain' is of class SpatRaster. In this case, the values of of the SpatRaster will be extracted to the 'predpoints'. In the case of any categorical features, Gower distances will be used to calculate the Nearest Neighbour distances [Experimental]. If categorical features are present, and 'clustering' = "kmeans", K-Prototype clustering will be performed instead.

Parameters

- `folds` (`integer(1)`)

Number of folds.

- `stratify`
  If `TRUE`, stratify on the target column.

Super class

`mlr3::Resampling` -> `ResamplingSpCVKnndm`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVKnndm$new()`
- `ResamplingSpCVKnndm$instantiate()`
- `ResamplingSpCVKnndm$clone()`

Method `new()`**:** Create a "K-fold Nearest Neighbour Distance Matching" resampling instance.

Usage:

```
ResamplingSpCVKnndm$new(id = "spcv_knndm")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVKnndm$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Linnenbrink, J., Mila, C., Ludwig, M., Meyer, H. (2023). "kNNDM: k-fold Nearest Neighbour Distance Matching Cross-Validation for map accuracy estimation." *EGUsphere*, **2023**, 1–16. doi:10.5194/egusphere20231308, https://egusphere.copernicus.org/preprints/2023/egusphere-2023-1308/.

Examples

```
if (mlr3misc::require_namespaces(c("sf", "CAST"), quietly = TRUE)) {
  library(mlr3)
  library(sf)

  set.seed(42)
  task = tsk("ecuador")
  points = sf::st_as_sf(task$coordinates(), crs = task$crs, coords = c("x", "y"))
  modeldomain = sf::st_as_sfc(sf::st_bbox(points))

  set.seed(42)
  cv_knndm = rsmp("spcv_knndm", modeldomain = modeldomain)
  cv_knndm$instantiate(task)

  #' ### Individual sets:
  # cv_knndm$train_set(1)
  # cv_knndm$test_set(1)
  # check that no obs are in both sets
  intersect(cv_knndm$train_set(1), cv_knndm$test_set(1)) # good!

  # Internal storage:
  # cv_knndm$instance # table
}
```

---

mlr_resamplings_spcv_tiles

(sperrorest) Spatial "Tiles" resampling

Description

Spatial partitioning using rectangular tiles. Small partitions can optionally be merged into adjacent ones to avoid partitions with too few observations. This method is similar to `ResamplingSpCVBlock` by making use of rectangular zones in the coordinate space. See the upstream implementation at `sperrorest::partition_disc()` and Brenning (2012) for further information.

Parameters

- `dsplit` (`integer(2)`)
  Equidistance of splits in (possibly rotated) x direction (`dsplit[1]`) and y direction (`dsplit[2]`) used to define tiles. If dsplit is of length 1, its value is recycled. Either `dsplit` or `nsplit` must be specified.
- `nsplit` (`integer(2)`)
  Number of splits in (possibly rotated) x direction (`nsplit[1]`) and y direction (`nsplit[2]`) used to define tiles. If `nsplit` is of length 1, its value is recycled.
- `rotation` (`character(1)`)
  Whether and how the rectangular grid should be rotated; random rotation is only possible between -45 and +45 degrees. Accepted values: One of `c("none", "random", "user")`.

- `user_rotation` (`character(1)`)
  Only used when `rotation = "user"`. Angle(s) (in degrees) by which the rectangular grid is to be rotated in each repetition. Either a vector of same length as `repeats`, or a single number that will be replicated `length(repeats)` times.
- `offset` (`logical(1)`)
  Whether and how the rectangular grid should be shifted by an offset. Accepted values: One of `c("none", "random", "user")`.
- `user_offset` (`logical(1)`)
  Only used when `offset = "user"`. A list (or vector) of two components specifying a shift of the rectangular grid in (possibly rotated) x and y direction. The offset values are relative values, a value of 0.5 resulting in a one-half tile shift towards the left, or upward. If this is a list, its first (second) component refers to the rotated x (y) direction, and both components must have same length as `repeats` (or length 1). If a vector of length 2 (or list components have length 1), the two values will be interpreted as relative shifts in (rotated) x and y direction, respectively, and will therefore be recycled as needed (`length(repeats)` times each).
- `reassign` (`logical(1)`)
  If `TRUE`, 'small' tiles (as per `min_frac` and `min_n`) are merged with (smallest) adjacent tiles. If `FALSE`, small tiles are 'eliminated', i.e., set to `NA`.
- `min_frac` (`numeric(1)`)
  Value must be >=0, <1. Minimum relative size of partition as percentage of sample.
- `min_n` (`integer(1)`)
  Minimum number of samples per partition.
- `iterate` (`integer(1)`)
  Passed down to `sperrorest::tile_neighbors()`.

Super class

`mlr3::Resampling` -> `ResamplingSpCVTiles`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSpCVTiles$new()`
- `ResamplingSpCVTiles$instantiate()`
- `ResamplingSpCVTiles$clone()`

Method `new()`**:** Create a "Spatial 'Tiles' resampling" resampling instance.

Usage:

```
ResamplingSpCVTiles$new(id = "spcv_tiles")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy. For a list of available arguments, please see sperrorest::partition_tiles.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSpCVTiles$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Brenning A (2012). "Spatial cross-validation and bootstrap for the assessment of prediction rules in remote sensing: The R package sperrorest." In *2012 IEEE International Geoscience and Remote Sensing Symposium*. doi:10.1109/igarss.2012.6352393.

See Also

ResamplingSpCVBlock

Examples

```
if (mlr3misc::require_namespaces("sperrorest", quietly = TRUE)) {
  library(mlr3)
  task = tsk("ecuador")

  # Instantiate Resampling
  rcv = rsmp("spcv_tiles", nsplit = c(4L, 3L), reassign = FALSE)
  rcv$instantiate(task)

  # Individual sets:
  rcv$train_set(1)
  rcv$test_set(1)
  # check that no obs are in both sets
  intersect(rcv$train_set(1), rcv$test_set(1)) # good!

  # Internal storage:
  rcv$instance # table
}
```

`mlr_resamplings_sptcv_cstf` *(CAST) Spatiotemporal "Leave-location-and-time-out" resampling*

Description

Splits data using Leave-Location-Out (LLO), Leave-Time-Out (LTO) and Leave-Location-and-Time-Out (LLTO) partitioning. See the upstream implementation at `CreateSpacetimeFolds()` (package **CAST**) and Meyer et al. (2018) for further information.

Details

LLO predicts on unknown locations i.e. complete locations are left out in the training sets. The `"space"` role in `Task$col_roles` identifies spatial units. If `stratify` is `TRUE`, the target distribution is similar in each fold. This is useful for land cover classification when the observations are polygons. In this case, LLO with stratification should be used to hold back complete polygons and have a similar target distribution in each fold. LTO leaves out complete temporal units which are identified by the `"time"` role in `Task$col_roles`. LLTO leaves out spatial and temporal units. See the examples.

Parameters

- `folds` (`integer(1)`)
  Number of folds.
- `stratify`
  If `TRUE`, stratify on the target column.

Super class

`mlr3::Resampling` -> `ResamplingSptCVCstf`

Active bindings

`iters integer(1)`
Returns the number of resampling iterations, depending on the values stored in the `param_set`.

Methods

Public methods:

- `ResamplingSptCVCstf$new()`
- `ResamplingSptCVCstf$instantiate()`
- `ResamplingSptCVCstf$clone()`

Method `new()`**:** Create a "Spacetime Folds" resampling instance.

Usage:

```
ResamplingSptCVCstf$new(id = "sptcv_cstf")
```

Arguments:

`id character(1)`
Identifier for the resampling strategy.

Method `instantiate()`**:** Materializes fixed training and test splits for a given task.

Usage:

```
ResamplingSptCVCstf$instantiate(task)
```

Arguments:

`task` mlr3::Task
A task to instantiate.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

References

Meyer H, Reudenbach C, Hengl T, Katurji M, Nauss T (2018). "Improving performance of spatio-temporal machine learning models using forward feature selection and target-oriented validation." *Environmental Modelling & Software*, **101**, 1–9. doi:10.1016/j.envsoft.2017.12.001.

Examples

```
library(mlr3)
task = tsk("cookfarm_mlr3")
task$set_col_roles("SOURCEID", roles = "space")
task$set_col_roles("Date", roles = "time")

# Instantiate Resampling
rcv = rsmp("sptcv_cstf", folds = 5)
rcv$instantiate(task)

### Individual sets:
# rcv$train_set(1)
# rcv$test_set(1)
# check that no obs are in both sets
intersect(rcv$train_set(1), rcv$test_set(1)) # good!

# Internal storage:
# rcv$instance # table
```

`mlr_tasks_cookfarm_mlr3`

Cookfarm Profiles Regression Task

Description

The R.J. Cook Agronomy Farm (cookfarm) is a Long-Term Agroecosystem Research Site operated by Washington State University, located near Pullman, Washington, USA. Contains spatio-temporal (3D+T) measurements of three soil properties and a number of spatial and temporal regression covariates.

Here, only the "Profiles" dataset is used from the collection. The `Date` column was appended from the `readings` dataset. In addition coordinates were appended to the task as variables `"x"` and `"y"`.

The dataset was borrowed and adapted from package GSIF which was on archived on CRAN in 2021-03.

Usage

```
data(cookfarm_mlr3)
```

Format

R6::R6Class inheriting from mlr3::TaskRegr.

Usage

```
mlr_tasks$get("cookfarm")
tsk("cookfarm_mlr3")
```

Column roles

The task has set column roles "space" and "time" for variables `"Date"` and `"SOURCEID"`, respectively. These are used by certain methods during partitioning, e.g., `mlr_resamplings_sptcv_cstf` with variant "Leave-location-and-time-out". If only one of space or time should left out, the column roles must be adjusted by the user!

References

Gasch, C.K., Hengl, T., Gräler, B., Meyer, H., Magney, T., Brown, D.J., 2015. Spatio-temporal interpolation of soil water, temperature, and electrical conductivity in 3D+T: the Cook Agronomy Farm data set. Spatial Statistics, 14, pp.70–90.

Gasch, C.K., D.J. Brown, E.S. Brooks, M. Yourek, M. Poggio, D.R. Cobos, C.S. Campbell, 2016? Retroactive calibration of soil moisture sensors using a two-step, soil-specific correction. Submitted to Vadose Zone Journal.

Gasch, C.K., D.J. Brown, C.S. Campbell, D.R. Cobos, E.S. Brooks, M. Chahal, M. Poggio, 2016? A field-scale sensor network data set for monitoring and modeling the spatial and temporal variation of soil moisture in a dryland agricultural field. Submitted to Water Resources Research.

See Also

Dictionary of Tasks: mlr3::mlr_tasks

`as.data.table(mlr_tasks)` for a complete table of all (also dynamically created) Tasks.

Other Task: `TaskClassifST`, `TaskRegrST`, `mlr_tasks_diplodia`, `mlr_tasks_ecuador`

`mlr_tasks_diplodia` *Diplodia Classification Task*

Description

Data set created by Patrick Schratz, University of Jena (Germany) and Eugenia Iturritxa, NEIKER, Vitoria-Gasteiz (Spain). This dataset should be cited as Schratz et al. (2019) (see reference below). The publication also contains additional information on data collection. The data set provided here shows infections of trees by the pathogen *Diplodia Sapinea* in the Basque Country in Spain. Predictors are environmental variables like temperature, precipitation, soil and more.

Usage

```
data(diplodia)
```

Format

R6::R6Class inheriting from mlr3::TaskClassif.

Usage

```
mlr_tasks$get("diplodia")
tsk("diplodia")
```

References

Schratz P, Muenchow J, Iturritxa E, Richter J, Brenning A (2019). "Hyperparameter tuning and performance assessment of statistical and machine-learning algorithms using spatial data." *Ecological Modelling*, **406**, 109–120. doi:10.1016/j.ecolmodel.2019.06.002.

See Also

Dictionary of Tasks: mlr3::mlr_tasks

`as.data.table(mlr_tasks)` for a complete table of all (also dynamically created) Tasks.

Other Task: `TaskClassifST`, `TaskRegrST`, `mlr_tasks_cookfarm_mlr3`, `mlr_tasks_ecuador`

mlr_tasks_ecuador *Ecuador Classification Task*

Description

Data set created by Jannes Muenchow, University of Erlangen-Nuernberg, Germany. This dataset should be cited as Muenchow et al. (2012) (see reference below). The publication also contains additional information on data collection and the geomorphology of the area. The data set provided here is (a subset of) the one from the 'natural' part of the RBSF area and corresponds to landslide distribution in the year 2000.

Usage

```
data(ecuador)
```

Format

R6::R6Class inheriting from mlr3::TaskClassif.

Usage

```
mlr_tasks$get("ecuador")
tsk("ecuador")
```

References

Muenchow, J., Brenning, A., Richter, M., 2012. Geomorphic process rates of landslides along a humidity gradient in the tropical Andes. Geomorphology, 139-140: 271-284.

See Also

Dictionary of Tasks: mlr3::mlr_tasks

`as.data.table(mlr_tasks)` for a complete table of all (also dynamically created) Tasks.

Other Task: `TaskClassifST`, `TaskRegrST`, `mlr_tasks_cookfarm_mlr3`, `mlr_tasks_diplodia`

TaskClassifST *Create a Spatiotemporal Classification Task*

Description

This task specializes mlr3::Task and mlr3::TaskSupervised for spatiotemporal classification problems. The target column is assumed to be a factor. The `task_type` is set to `"classif"` and `"spatiotemporal"`.

A spatial example task is available via `tsk("ecuador")`, a spatiotemporal one via `tsk("cookfarm_mlr3")`.

The coordinate reference system passed during initialization must match the one which was used during data creation, otherwise offsets of multiple meters may occur. By default, coordinates are not used as features. This can be changed by setting `coords_as_features = TRUE`.

Super classes

mlr3::Task -> mlr3::TaskSupervised -> mlr3::TaskClassif -> TaskClassifST

Active bindings

crs (character(1))
: Returns coordinate reference system of task.

coordinate_names (character())
: Coordinate names.

coords_as_features (logical(1))
: If TRUE, coordinates are used as features. This is a shortcut for task$set_col_roles(c("x", "y"), role = "feature") with the assumption that the coordinates in the data are named "x" and "y".

Methods

Public methods:

- TaskClassifST$new()
- TaskClassifST$coordinates()
- TaskClassifST$print()
- TaskClassifST$clone()

Method new(): Create a new spatiotemporal resampling Task

Usage:

```
TaskClassifST$new(
  id,
  backend,
  target,
  positive = NULL,
  label = NA_character_,
  coordinate_names,
  crs = NA_character_,
  coords_as_features = FALSE,
  extra_args = list()
)
```

Arguments:

id (character(1))
: Identifier for the new instance.

backend (mlr3::DataBackend)
: Either a mlr3::DataBackend, or any object which is convertible to a mlr3::DataBackend with as_data_backend(). E.g., am sf will be converted to a mlr3::DataBackendDataTable.

target (character(1))
: Name of the target column.

positive (character(1))
: Only for binary classification: Name of the positive class. The levels of the target columns are reordered accordingly, so that the first element of $class_names is the positive class, and the second element is the negative class.

`label` (`character(1)`)
Label for the new instance. Shown in `as.data.table(mlr_tasks)`.

`coordinate_names` (`character(1)`)
The column names of the coordinates in the data.

`crs` (`character(1)`)
Coordinate reference system. WKT2 or EPSG string.

`coords_as_features` (`logical(1)`)
If `TRUE`, coordinates are used as features. This is a shortcut for `task$set_col_roles(c("x", "y"), role = "feature")` with the assumption that the coordinates in the data are named `"x"` and `"y"`.

`extra_args` (named `list()`)
Named list of constructor arguments, required for converting task types via `mlr3::convert_task()`.

Method `coordinates()`**:** Returns coordinates of observations.

Usage:

```
TaskClassifST$coordinates(row_ids = NULL)
```

Arguments:

`row_ids` (`integer()`)
Vector of rows indices as subset of `task$row_ids`.

Returns: `data.table::data.table()`

Method `print()`**:** Print the task.

Usage:

```
TaskClassifST$print(...)
```

Arguments:

`...` Arguments passed to the `$print()` method of the superclass.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

See Also

Other Task: `TaskRegrST`, `mlr_tasks_cookfarm_mlr3`, `mlr_tasks_diplodia`, `mlr_tasks_ecuador`

Examples

```
if (mlr3misc::require_namespaces(c("sf", "blockCV"), quietly = TRUE)) {
  task = as_task_classif_st(ecuador,
    target = "slides",
    positive = "TRUE", coordinate_names = c("x", "y")
  )

  # passing objects of class 'sf' is also supported
```

```
  data_sf = sf::st_as_sf(ecuador, coords = c("x", "y"))
  task = as_task_classif_st(data_sf, target = "slides", positive = "TRUE")

  task$task_type
  task$formula()
  task$class_names
  task$positive
  task$negative
  task$coordinates()
  task$coordinate_names
}
```

TaskRegrST *Create a Spatiotemporal Regression Task*

Description

This task specializes mlr3::Task and mlr3::TaskSupervised for spatiotemporal classification problems.

A spatial example task is available via `tsk("ecuador")`, a spatiotemporal one via `tsk("cookfarm_mlr3")`.

The coordinate reference system passed during initialization must match the one which was used during data creation, otherwise offsets of multiple meters may occur. By default, coordinates are not used as features. This can be changed by setting `coords_as_features = TRUE`.

Super classes

`mlr3::Task` -> `mlr3::TaskSupervised` -> `mlr3::TaskRegr` -> TaskRegrST

Active bindings

`crs (character(1))`
: Returns coordinate reference system of task.

`coordinate_names (character())`
: Coordinate names.

`coords_as_features (logical(1))`
: If `TRUE`, coordinates are used as features. This is a shortcut for `task$set_col_roles(c("x", "y"), role = "feature")` with the assumption that the coordinates in the data are named `"x"` and `"y"`.

Methods

Public methods:

- `TaskRegrST$new()`
- `TaskRegrST$coordinates()`
- `TaskRegrST$print()`

- TaskRegrST$clone()

Method new(): Create a new spatiotemporal resampling Task Returns coordinates of observations.

Usage:

```
TaskRegrST$new(
  id,
  backend,
  target,
  label = NA_character_,
  coordinate_names,
  crs = NA_character_,
  coords_as_features = FALSE,
  extra_args = list()
)
```

Arguments:

id (character(1))
: Identifier for the new instance.

backend (mlr3::DataBackend)
: Either a mlr3::DataBackend, or any object which is convertible to a mlr3::DataBackend with as_data_backend(). E.g., am sf will be converted to a mlr3::DataBackendDataTable.

target (character(1))
: Name of the target column.

label (character(1))
: Label for the new instance. Shown in as.data.table(mlr_tasks).

coordinate_names (character(1))
: The column names of the coordinates in the data.

crs (character(1))
: Coordinate reference system. WKT2 or EPSG string.

coords_as_features (logical(1))
: If TRUE, coordinates are used as features. This is a shortcut for task$set_col_roles(c("x", "y"), role = "feature") with the assumption that the coordinates in the data are named "x" and "y".

extra_args (named list())
: Named list of constructor arguments, required for converting task types via mlr3::convert_task().

Method coordinates():

Usage:

```
TaskRegrST$coordinates(row_ids = NULL)
```

Arguments:

row_ids (integer())
: Vector of rows indices as subset of task$row_ids.

Returns: data.table::data.table()

Method print(): Print the task.

Usage:

```
TaskRegrST$print(...)
```

Arguments:

`...` Arguments passed to the `$print()` method of the superclass.

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

Usage:

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

Arguments:

`deep` Whether to make a deep clone.

See Also

Other Task: `TaskClassifST`, `mlr_tasks_cookfarm_mlr3`, `mlr_tasks_diplodia`, `mlr_tasks_ecuador`

Index

∗ **Task**
mlr_tasks_cookfarm_mlr3, 69
mlr_tasks_diplodia, 70
mlr_tasks_ecuador, 71
TaskClassifST, 71
TaskRegrST, 74
∗ **datasets**
mlr_tasks_cookfarm_mlr3, 69
mlr_tasks_diplodia, 70
mlr_tasks_ecuador, 71

as_task_classif_st, 5
as_task_regr_st *(*as_task_regr_st.TaskClassifST*)*, 7
as_task_regr_st.TaskClassifST, 7
autoplot.ResamplingCustomCV, 10
autoplot.ResamplingCV, 11
autoplot.ResamplingCV(), *11*, *15*, *17*, *19*, *22*, *24*, *26*, *29*, *32*
autoplot.ResamplingRepeatedCV *(*autoplot.ResamplingCV*)*, 11
autoplot.ResamplingRepeatedSpCVBlock *(*autoplot.ResamplingSpCVBlock*)*, 13
autoplot.ResamplingRepeatedSpCVCoords *(*autoplot.ResamplingSpCVCoords*)*, 18
autoplot.ResamplingRepeatedSpCVDisc *(*autoplot.ResamplingSpCVDisc*)*, 20
autoplot.ResamplingRepeatedSpCVEnv *(*autoplot.ResamplingSpCVEnv*)*, 22
autoplot.ResamplingRepeatedSpCVKnndm *(*autoplot.ResamplingSpCVKnndm*)*, 24
autoplot.ResamplingRepeatedSpCVTiles *(*autoplot.ResamplingSpCVTiles*)*, 27
autoplot.ResamplingRepeatedSptCVCstf *(*autoplot.ResamplingSptCVCstf*)*, 29
autoplot.ResamplingSpCVBlock, 13
autoplot.ResamplingSpCVBlock(), *11*, *13*, *17*, *19*, *22*, *24*, *26*, *28*, *32*
autoplot.ResamplingSpCVBuffer, 16
autoplot.ResamplingSpCVBuffer(), *11*, *13*, *15*, *19*, *22*, *24*, *26*, *29*, *32*
autoplot.ResamplingSpCVCoords, 18
autoplot.ResamplingSpCVCoords(), *11*, *13*, *15*, *17*, *22*, *24*, *26*, *29*, *32*
autoplot.ResamplingSpCVDisc, 20
autoplot.ResamplingSpCVDisc(), *11*, *13*, *15*, *19*, *24*, *29*
autoplot.ResamplingSpCVEnv, 22
autoplot.ResamplingSpCVEnv(), *11*, *13*, *15*, *17*, *19*, *22*, *26*, *29*, *32*
autoplot.ResamplingSpCVKnndm, 24
autoplot.ResamplingSpCVTiles, 27
autoplot.ResamplingSpCVTiles(), *11*, *13*, *15*, *19*, *22*, *24*, *26*
autoplot.ResamplingSptCVCstf, 29
autoplot.ResamplingSptCVCstf(), *11*, *13*, *15*, *17*, *19*, *24*

blockCV::cv_buffer, *54*
blockCV::cv_buffer(), *55*
blockCV::cv_cluster, *41*, *60*
blockCV::cv_spatial, *33*, *34*, *52*
blockCV::cv_spatial(), *33*, *52*, *53*

cookfarm_mlr3 *(*mlr_tasks_cookfarm_mlr3*)*, 69
cv_buffer, *33*, *52*
cv_spatial_autocor, *54*

data.frame(), *5*, *7*
data.table::data.table(), *73*, *75*
Dictionary, *70*, *71*

diplodia *(*mlr_tasks_diplodia*)*, 70

ecuador *(*mlr_tasks_ecuador*)*, 71

ggplot2::ggplot(), *15*
ggsci::scale_color_ucscgb(), *15*

mlr3::convert_task(), *5*, *7*, *73*, *75*
mlr3::DataBackend, *5*, *7*, *72*, *75*
mlr3::DataBackendDataTable, *72*, *75*
mlr3::mlr_tasks, *70, 71*
mlr3::Resampling, *34*, *36*, *38*, *41*, *44*, *47*, *49*, *52*, *55, 56*, *58*, *60*, *63*, *65*, *67*
mlr3::ResamplingCustomCV, *10, 11*
mlr3::ResamplingCV, *12, 13*
mlr3::ResamplingRepeatedCV, *12, 13*
mlr3::Task, *35*, *37*, *39*, *42*, *45*, *48*, *50*, *53*, *55*, *57*, *59*, *61*, *63*, *66*, *68*, *71, 72*, *74*
mlr3::TaskClassif, *7*, *70–72*
mlr3::TaskRegr, *5*, *69*, *74*
mlr3::TaskSupervised, *71, 72*, *74*
mlr3spatiotempcv *(*mlr3spatiotempcv-package*)*, 3
mlr3spatiotempcv-package, 3
mlr_resamplings_repeated_spcv_block, 32
mlr_resamplings_repeated_spcv_coords, 36
mlr_resamplings_repeated_spcv_disc, 38
mlr_resamplings_repeated_spcv_env, 40
mlr_resamplings_repeated_spcv_knndm, 42
mlr_resamplings_repeated_spcv_tiles, 46
mlr_resamplings_repeated_sptcv_cstf, 49
mlr_resamplings_spcv_block, 51
mlr_resamplings_spcv_buffer, 54
mlr_resamplings_spcv_coords, 56
mlr_resamplings_spcv_disc, 58
mlr_resamplings_spcv_env, 60
mlr_resamplings_spcv_knndm, 61
mlr_resamplings_spcv_tiles, 64
mlr_resamplings_sptcv_cstf, 67
mlr_tasks_cookfarm_mlr3, 69, *70, 71*, *73*, *76*
mlr_tasks_diplodia, *70*, 70, *71*, *73*, *76*
mlr_tasks_ecuador, *70*, 71, *73*, *76*

plot.ResamplingCustomCV *(*autoplot.ResamplingCustomCV*)*, 10
plot.ResamplingCV *(*autoplot.ResamplingCV*)*, 11
plot.ResamplingRepeatedCV *(*autoplot.ResamplingCV*)*, 11
plot.ResamplingRepeatedSpCVBlock *(*autoplot.ResamplingSpCVBlock*)*, 13
plot.ResamplingRepeatedSpCVCoords *(*autoplot.ResamplingSpCVCoords*)*, 18
plot.ResamplingRepeatedSpCVDisc *(*autoplot.ResamplingSpCVDisc*)*, 20
plot.ResamplingRepeatedSpCVEnv *(*autoplot.ResamplingSpCVEnv*)*, 22
plot.ResamplingRepeatedSpCVKnndm *(*autoplot.ResamplingSpCVKnndm*)*, 24
plot.ResamplingRepeatedSpCVTiles *(*autoplot.ResamplingSpCVTiles*)*, 27
plot.ResamplingRepeatedSptCVCstf *(*autoplot.ResamplingSptCVCstf*)*, 29
plot.ResamplingSpCVBlock *(*autoplot.ResamplingSpCVBlock*)*, 13
plot.ResamplingSpCVBuffer *(*autoplot.ResamplingSpCVBuffer*)*, 16
plot.ResamplingSpCVCoords *(*autoplot.ResamplingSpCVCoords*)*, 18
plot.ResamplingSpCVDisc *(*autoplot.ResamplingSpCVDisc*)*, 20
plot.ResamplingSpCVEnv *(*autoplot.ResamplingSpCVEnv*)*, 22
plot.ResamplingSpCVKnndm *(*autoplot.ResamplingSpCVKnndm*)*, 24
plot.ResamplingSpCVTiles *(*autoplot.ResamplingSpCVTiles*)*,

27
plot.ResamplingSptCVCstf
(autoplot.ResamplingSptCVCstf), 29

R6::R6Class, 69–71
ResamplingRepeatedSpCVBlock, 14, 21, 25, 28
ResamplingRepeatedSpCVBlock
(mlr_resamplings_repeated_spcv_block), 32
ResamplingRepeatedSpCVCoords, 19
ResamplingRepeatedSpCVCoords
(mlr_resamplings_repeated_spcv_coords), 36
ResamplingRepeatedSpCVDisc
(mlr_resamplings_repeated_spcv_disc), 38
ResamplingRepeatedSpCVEnv, 23, 24
ResamplingRepeatedSpCVEnv
(mlr_resamplings_repeated_spcv_env), 40
ResamplingRepeatedSpCVKnndm
(mlr_resamplings_repeated_spcv_knndm), 42
ResamplingRepeatedSpCVTiles
(mlr_resamplings_repeated_spcv_tiles), 46
ResamplingRepeatedSptCVCstf, 30, 31
ResamplingRepeatedSptCVCstf
(mlr_resamplings_repeated_sptcv_cstf), 49
ResamplingSpCVBlock, 14, 15, 21, 25, 26, 28
ResamplingSpCVBlock
(mlr_resamplings_spcv_block), 51
ResamplingSpCVBuffer, 15, 17, 21, 26, 28
ResamplingSpCVBuffer
(mlr_resamplings_spcv_buffer), 54
ResamplingSpCVCoords, 15, 19, 21, 26, 28
ResamplingSpCVCoords
(mlr_resamplings_spcv_coords), 56
ResamplingSpCVDisc
(mlr_resamplings_spcv_disc), 58
ResamplingSpCVEnv, 15, 21, 23, 24, 26, 28
ResamplingSpCVEnv
(mlr_resamplings_spcv_env), 60
ResamplingSpCVKnndm
(mlr_resamplings_spcv_knndm), 61
ResamplingSpCVTiles
(mlr_resamplings_spcv_tiles), 64
ResamplingSptCVCstf, 30, 31
ResamplingSptCVCstf
(mlr_resamplings_sptcv_cstf), 67

sf::sf, 5, 7
sperrorest::partition_cv, 36, 57
sperrorest::partition_disc, 38, 58
sperrorest::partition_tiles, 47, 66
sperrorest::tile_neighbors(), 47, 65

TaskClassifST, 5, 6, 70, 71, 71, 76
TaskRegrST, 7, 9, 70, 71, 73, 74
Tasks, 70, 71