Title Dynamic Ensembles for Time Series Forecasting

Version 0.1.0

Author Vitor Cerqueira [aut, cre],
Luis Torgo [ctb],
Carlos Soares [ctb]

Maintainer Vitor Cerqueira <cerqueira.vitormanuel@gmail.com>


Imports xts, zoo, RcppRoll, methods, ranger, glmnet, earth, kernlab, Cubist, gbm, pls, monmlp, doParallel, foreach, xgboost, softImpute

Suggests testthat

License GPL (>= 2)

Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

URL https://github.com/vcerqueira/tsensembler

Date/Publication 2020-10-27 14:00:02 UTC
Description

Arbitrated Dynamic Ensemble (ADE) is an ensemble approach for adaptively combining forecasting models. A metalearning strategy is used that specializes base models across the time series. Each meta-learner is specifically designed to model how apt its base counterpart is to make a prediction for a given test example. This is accomplished by analysing how the error incurred by a given learning model relates to the characteristics of the data. At test time, the base-learners are weighted according to their degree of competence in the input observation, estimated by the predictions of the meta-learners.

Usage

```
ADE(
    form,  
data,  
    specs,  
    lambda = 50,  
    omega = 0.5,  
    select_best = FALSE,  
    all_models = FALSE,  
    aggregation = "linear",  
)```
ADE

```r
classicADE(
  form,
  data,
  specs,
  sequential_reweight = FALSE,
  meta_loss_fun = ae,
  meta_model_type = "randomforest",
  num_cores = 1
)

quickADE(
  form,
  data,
  specs,
  lambda = 50,
  omega = 0.5,
  select_best = FALSE,
  all_models = FALSE,
  aggregation = "linear",
  sequential_reweight = FALSE,
  meta_loss_fun = ae,
  meta_model_type = "randomforest",
  num_cores = 1
)
```

**Arguments**

- `form` formula; object to train the base models.
- `data` data to be used.
- `specs` object of class `model_specs-class`. Contains the parameter setting information for training the base models.
- `lambda` window size. Number of observations to compute the recent performance of the base models, according to the committee ratio `omega`. Essentially, the top `omega` models are selected and weighted at each prediction instance, according to their performance in the last `lambda` observations. Defaults to 50 according to empirical experiments.
- `omega` committee ratio size. Essentially, the top `omega` * 100 percent of models are selected and weighted at each prediction instance, according to their performance in the last `lambda` observations. Defaults to .5 according to empirical experiments.
- `select_best` Logical. If true, at each prediction time, a single base model is picked to make a prediction. The picked model is the one that has the lowest loss prediction from the meta models. Defaults to FALSE.
- `all_models` Logical. If true, at each prediction time, all base models are picked to make a prediction. The models are weighted according to their predicted loss and the aggregation function. Defaults to FALSE.
- `aggregation` Type of aggregation used to combine the predictions of the base models. The options are:
  - `softmax` default
  - `erfc` the complementary Gaussian error function
linear a linear scaling

Besides ensemble heterogeneity we encourage diversity explicitly during the aggregation of the output of experts. This is achieved by taking into account not only predictions of performance produced by the arbiters, but also the correlation among experts in a recent window of observations.

Besides

meta model to use – defaults to random forest

A numeric value to specify the number of cores used to train base and meta models. num_cores = 1 leads to sequential training of models. num_cores > 1 splits the training of the base models across num_cores cores.

References


See Also

model_specs-class for setting up the ensemble parameters for an ADE model; predict for the method that predicts new held out observations; update_weights for the method used to update the weights of an ADE model between successive predict or forecast calls; update_ade_meta for updating (retraining) the meta models of an ADE model; update_base_models for the updating (retraining) the base models of an ADE ensemble (and respective weights); ade_hat-class for the object that results from predicting with an ADE model; and update_ade to update an ADE model, combining functions update_base_models, update_meta_ade, and update_weights.

Examples

```r
specs <- model_specs(
  learner = c("bm_ppr", "bm_glm", "bm_mars"),
  learner_pars = list(
    bm_glm = list(alpha = c(0, .5, 1)),
    bm_svr = list(kernel = c("rbfdot", "polydot"),
                   C = c(1, 3)),
    bm_ppr = list(nterms = 4)
  )
)

data("water_consumption")
train <- embed_timeseries(water_consumption, 5)
train <- train[1:300, ] # toy size for checks

model <- ADE(target ~., train, specs)
```
base_ensemble

Description

**base_ensemble** is a S4 class that contains the base models comprising the ensemble. Besides the base learning algorithms – **base_models** – base_ensemble class contains information about other meta-data used to compute predictions for new upcoming data.

Usage

base_ensemble(base_models, pre_weights, form, colnames)

Arguments

- **base_models** a list comprising the base models;
- **pre_weights** normalized relative weights of the base learners according to their performance on the available data;
- **form** formula;
- **colnames** names of the columns of the data used to train the **base_models**;

build_base_ensemble

Wrapper for creating an ensemble

Description

Using the parameter specifications from **model_specs-class**, this function trains a set of regression models.

Usage

build_base_ensemble(form, data, specs, num_cores = 1)

Arguments

- **form** formula;
- **data** data.frame for training the predictive models;
- **specs** object of class **model_specs-class**. Contains the information about the parameter setting of the models to train.
- **num_cores** number of cores
Value

An S4 class with the following slots: **base_models**, a list containing the trained models; **pre_weights**, a numeric vector describing the weights of the base models according to their performance in the training data; and **colnames**, the column names of the data, used for reference.

Examples

```r
data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
specs <- model_specs(c("bm_ppr","bm_svr"), NULL)
M <- build_base_ensemble(target ~ ., dataset, specs, 1)
```

---

**DETS**

*Dynamic Ensemble for Time Series*

Description

A Dynamic Ensemble for Time Series (DETS). The DETS ensemble method we present settles on individually pre-trained models which are dynamically combined at run-time to make a prediction. The combination rule is reactive to changes in the environment, rendering an online combined model. The main properties of the ensemble are:

**heterogeneity** Heterogeneous ensembles are those comprised of different types of base learners. By employing models that follow different learning strategies, use different features and/or data observations we expect that individual learners will disagree with each other, introducing a natural diversity into the ensemble that helps in handling different dynamic regimes in a time series forecasting setting.

**responsiveness** We promote greater responsiveness of heterogeneous ensembles in time series tasks by making the aggregation of their members’ predictions time-dependent. By tracking the loss of each learner over time, we weigh the predictions of individual learners according to their recent performance using a non-linear function. This strategy may be advantageous for better detecting regime changes and also to quickly adapt the ensemble to new regimes.

Usage

```r
DETS(
  form,
  data,
  specs,
  lambda = 50,
  omega = 0.5,
  select_best = FALSE,
  num_cores = 1
)
```
Arguments

- `form`: formula;
- `data`: data frame to train the base models;
- `specs`: object of class `model_specs-class`. Contains the parameter setting information for training the base models;
- `lambda`: window size. Number of observations to compute the recent performance of the base models, according to the committee ratio `omega`. Essentially, the top `omega` models are selected and weighted at each prediction instance, according to their performance in the last `lambda` observations. Defaults to 50 according to empirical experiments;
- `omega`: committee ratio size. Essentially, the top `omega` models are selected and weighted at each prediction instance, according to their performance in the last `lambda` observations. Defaults to .5 according to empirical experiments;
- `select_best`: Logical. If true, at each prediction time, a single base model is picked to make a prediction. The picked model is the one that has the lowest loss prediction from the meta models. Defaults to FALSE;
- `num_cores`: A numeric value to specify the number of cores used to train base and meta models. `num_cores = 1` leads to sequential training of models. `num_cores > 1` splits the training of the base models across `num_cores` cores.

References


See Also

- `model_specs-class` for setting up the ensemble parameters for an `DETS` model; `predict` for the method that predicts new held out observations; `update_weights` for the method used to update the weights of an `DETS` model between successive predict or forecast calls; `update_base_models` for the updating (retraining) the base models of an `DETS` ensemble (and respective weights); and `dets_hat-class` for the object that results from predicting with an `DETS` model.

Examples

```r
specs <- model_specs(
  c("bm_ppr", "bm_svr"),
  list(bm_ppr = list(nterms = c(2, 4)),
       bm_svr = list(kernel = c("vanilladot", "polydot"), C = c(1,5)))
)
data("water_consumption");
train <- embed_timeseries(water_consumption, 5);
model <- DETS(target ~., train, specs, lambda = 30, omega = .2)
```
**embed_timeseries**

**Embedding a Time Series**

**Description**

This function embeds a time series into an Euclidean space. This implementation is based on the function `embed` of the `stats` package and has theoretical background on reconstruction of attractors (see Takens, 1981). This shape transformation of the series allows for the use of any regression tool available to learn the time series. The assumption is that there are no long-term dependencies in the data.

**Usage**

```r
embed_timeseries(timeseries, embedding.dimension)
```

**Arguments**

- `timeseries`:
  
a time series of class "xts".

- `embedding.dimension`:
  
an integer specifying the embedding dimension.

**Value**

An embedded time series

**See Also**

`embed` for the details of the embedding procedure.

**Examples**

```r
## Not run:
require(xts)
ts <- as.xts(rnorm(100L), order.by = Sys.Date() + rnorm(100L))
embedded.ts <- embed_timeseries(ts, 20L)

## End(Not run)
```
learning_base_models  

Training the base models of an ensemble

**Description**

This function uses `train` to build a set of predictive models, according to `specs`

**Usage**

```r
learning_base_models(train, form, specs, num_cores)
```

**Arguments**

- `train` training set to build the predictive models;
- `form` formula;
- `specs` object of class `model_specs-class`
- `num_cores` A numeric value to specify the number of cores used to train base and meta models. `num_cores = 1` leads to sequential training of models. `num_cores > 1` splits the training of the base models across `num_cores` cores.

**Value**

A series of predictive models (`base_model`), and the weights of the models computed in the training data (`preweights`).

**See Also**

`build_base_ensemble`

**Examples**

```r
data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
specs <- model_specs(c("bm_ppr","bm_svr"), NULL)
M <- build_base_ensemble(target ~., dataset, specs, 1)
```
**meta_xgb_predict**  
_Arbitrator predictions via xgb_

**Description**

Arbitrator predictions via xgb

**Usage**

```r
meta_xgb_predict(meta_model, newdata)
```

**Arguments**

- `meta_model`: arbiter – a ranger object
- `newdata`: new data to predict

---

**model_recent_performance**  
_Recent performance of models using EMASE_

**Description**

This function computes EMASE, Erfc Moving Average Squared Error, to quantify the recent performance of the base models.

**Usage**

```r
model_recent_performance(Y_hat, Y, lambda, omega, pre_weights)
```

**Arguments**

- `Y_hat`: A `data.frame` containing the predictions of each base model;
- `Y`: know true values from past data to compare the predictions to;
- `lambda`: Window size. Number of periods to average over when computing MASE;
- `omega`: Ratio of top models in the committee;
- `pre_weights`: The initial weights of the models, computed in the available data during the learning phase;

**Value**

A list containing two objects:

- `model_scores`: The weights of the models in each time point
- `top_models`: Models in the committee in each time point
model_specs

See Also

Other weighting base models: EMASE(), build_committee(), get_top_models(), model_weighting(), select_best()

model_specs  Setup base learning models

Description

This class sets up the base learning models and respective parameters setting to learn the ensemble.

Usage

model_specs(learner, learner_pars = NULL)

Arguments

learner  character vector with the base learners to be trained. Currently available models are:

- **bm_gaussianprocess**  Gaussian Process models, from the kernlab package. See gausspr for a complete description and possible parametrization. See bm_gaussianprocess for the function implementation.
- **bm_ppr**  Projection Pursuit Regression models, from the stats package. See ppr for a complete description and possible parametrization. See bm_ppr for the function implementation.
- **bm_glm**  Generalized Linear Models, from the glmnet package. See glmnet for a complete description and possible parametrization. See bm_glm for the function implementation.
- **bm_gbm**  Generalized Boosted Regression models, from the gbm package. See gbm for a complete description and possible parametrization. See bm_gbm for the function implementation.
- **bm_randomforest**  Random Forest models, from the ranger package. See ranger for a complete description and possible parametrization. See bm_randomforest for the function implementation.
- **bm_cubist**  M5 tree models, from the Cubist package. See cubist for a complete description and possible parametrization. See bm_cubist for the function implementation.
- **bm_mars**  Multivariate Adaptive Regression Splines models, from the earth package. See earth for a complete description and possible parametrization. See bm_mars for the function implementation.
- **bm_svr**  Support Vector Regression models, from the kernlab package. See ksvm for a complete description and possible parametrization. See bm_svr for the function implementation.
- **bm_ffnn**  Feedforward Neural Network models, from the nnet package. See nnet for a complete description and possible parametrization. See bm_ffnn for the function implementation.
`bm_pls_pcr`  Partial Least Regression and Principal Component Regression models, from the `pls` package. See `mvr` for a complete description and possible parametrization. See `bm_pls_pcr` for the function implementation.

`learner_pars`  a list with parameter setting for the `learner`. For each model, an inner list should be created with the specified parameters.

Check each implementation to see the possible variations of parameters (also examplified below).

**Examples**

```r
# A PPR model and a GLM model with default parameters
data(model_specs(learner = c("bm_ppr", "bm_glm"), learner_pars = NULL))
```

```r
# A PPR model and a SVR model. The listed parameters are combined
# with a cartesian product.
# With these specifications an ensemble with 6 predictive base
# models will be created. Two PPR models, one with 2 nterms
# and another with 4; and 4 SVR models, combining the kernel
# and C parameters.
specs <- model_specs(
c("bm_ppr", "bm_svr"),
list(bm_ppr = list(nterms = c(2, 4)),
   bm_svr = list(kernel = c("vanilladot", "polydot"), C = c(1,5)))
)
```

```r
# All parameters currently available (parameter values can differ)
data(model_specs(
learner = c("bm_ppr", "bm_svr", "bm_randomforest",
   "bm_gaussianprocess", "bm_cubist", "bm_glm",
   "bm_gbm", "bm_pls_pcr", "bm_ffnn", "bm_mars"),
learner_pars = list(
  bm_ppr = list(
    nterms = c(2,4),
    sm.method = "supsmu"
  ),
  bm_svr = list(
    kernel = "rbfdot",
    C = c(1,5),
    epsilon = .01
  ),
  bm_glm = list(
    alpha = c(1, 0)
  ),
  bm_randomforest = list(
    num.trees = 500
  ),
  bm_gbm = list(
    interaction.depth = 1,
    shrinkage = c(.01, .005),
    n.trees = c(100)
  )
)
```
model_weighting

Model weighting

Description

This is an utility function that takes the raw error of models and scales them into a 0-1 range according to one of three strategies:

Usage

model_weighting(x, trans = "softmax", ...)

Arguments

x A object describing the loss of each base model
trans Character value describing the transformation type. The available options are softmax, linear and erfc. The softmax and erfc provide a non-linear transformation where the weights decay exponentially as the relative loss of a given model increases (with respect to all available models). The linear transformation is a simple normalization of values using the max-min method.
... Further arguments to normalize and proportion functions \(\text{na.rm = TRUE}\)
Details

**erfc** using the complementary Gaussian error function

**softmax** using a softmax function

**linear** A simple normalization using max-min method

These transformations culminate into the final weights of the models.

Value

An object describing the weights of models

See Also

Other weighting base models: `EMASE()`, `build_committee()`, `get_top_models()`, `model_recent_performance()`, `select_best()`

---

**predict**

*Predicting new observations using an ensemble*

Description

Initially, the predictions of the base models are collected. Then, the predictions of the loss to be incurred by the base models $E_{\text{hat}}$ (estimated by their associate meta models) are computed. The weights of the base models are then estimated according to $E_{\text{hat}}$ and the committee of top models. The committee is built according to the $\lambda$ and $\omega$ parameters. Finally, the predictions are combined according to the weights and the committee setup.

Usage

```r
## S4 method for signature 'ADE'
predict(object, newdata)

## S4 method for signature 'DETS'
predict(object, newdata)

## S4 method for signature 'base_ensemble'
predict(object, newdata)
```

Arguments

- **object** an object of class `ADE-class`
- **newdata** new data to predict
Examples

```r
##### Predicting with an ADE ensemble

specs <- model_specs(
  learner = c("bm_glm", "bm_mars"),
  learner_pars = NULL
)

data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
train <- dataset[1:1000, ]

model <- ADE(target ~., train, specs)
preds <- predict(model, test)
```

```r
## Not run:
```

```
##### Predicting with a DETS ensemble

specs <- model_specs(
  learner = c("bm_svr", "bm_glm", "bm_mars"),
  learner_pars = NULL
)

data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
train <- dataset[1:700, ]

model <- DETS(target ~., train, specs, lambda = 50, omega = .2)
preds <- predict(model, test)
```

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

```r
## Not run:
```

```
##### Predicting with a base ensemble

model <- ADE(target ~., train, specs)

basepreds <- predict(model@base_ensemble, test)
```

```r
## End(Not run)
```
tsensembler  Dynamic Ensembles for Time Series Forecasting

Description

This package implements ensemble methods for time series forecasting tasks. Dynamically combining different forecasting models is a common approach to tackle these problems.

Details

The main methods in tsensembler are in ADE-class and DETS-class:

ADE  Arbitrated Dynamic Ensemble (ADE) is an ensemble approach for dynamically combining forecasting models using a metalearning strategy called arbitrating. A meta model is trained for each base model in the ensemble. Each meta-learner is specifically designed to model the error of its associate across the time series. At forecasting time, the base models are weighted according to their degree of competence in the input observation, estimated by the predictions of the meta models.

DETS  Dynamic Ensemble for Time Series (DETS) is similar to ADE in the sense that it adaptively combines the base models in an ensemble for time series forecasting. DETS follows a more traditional approach for forecaster combination. It pre-trains a set of heterogeneous base models, and at run-time weights them dynamically according to recent performance. Like ADE, the ensemble includes a committee, which dynamically selects a subset of base models that are weighted with a non-linear function.

The ensemble methods can be used to predict new observations or forecast future values of a time series. They can also be updated using generic functions (check see also section).

References


See Also

ADE-class for setting up an ADE model; and DETS-class for setting up a DETS model; see also update_weights and update_base_models to check the generic function for updating the predictive models in an ensemble.
Examples

## Not run:
data("water_consumption")
# embedding time series into a matrix
dataset <- embed_timeseries(water_consumption, 5)

# splitting data into train/test
train <- dataset[1:1000,]
test <- dataset[1001:1020,]

# setting up base model parameters
specs <- model_specs(
  learner = c("bm_ppr","bm_glm","bm_svr","bm_mars"),
  learner_pars = list(
    bm_glm = list(alpha = c(0, .5, 1)),
    bm_svr = list(kernel = c("rbfdot","polydot"),
                   C = c(1,3)),
    bm_ppr = list(nterms = 4)
  )
)

# building the ensemble
model <- ADE(target ~., train, specs)

# forecast next value and update base and meta models
# every three points;
# in the other points, only the weights are updated
predictions <- numeric(nrow(test))
for (i in seq_along(predictions)) {
  predictions[i] <- predict(model, test[i,])@y_hat
  if (i %% 3 == 0) {
    model <-
      update_base_models(model, rbind.data.frame(train, test[seq_len(i),]))
    model <- update_ade_meta(model, rbind.data.frame(train, test[seq_len(i),]))
  } else {
    model <- update_weights(model, test[i,])
  }
}

point_forecast <- forecast(model, h = 5)

# setting up an ensemble of support vector machines
specs2 <-
  model_specs(learner = c("bm_svr"),
              learner_pars = list(
                bm_svr = list(kernel = c("vanilladot","polydot","rbfdot"),
                                 C = c(1,3,6)))
model <- DETS(target ~ ., train, specs2)
preds <- predict(model, test)$y_hat

## End(Not run)

---

**update_ade**  
*Updating an ADE model*

**Description**

*update_ade* is a generic function that combines *update_base_models, update_ade_meta*, and *update_weights*.

**Usage**

```r
update_ade(object, newdata, num_cores = 1)
```

## S4 method for signature 'ADE'
update_ade(object, newdata, num_cores = 1)

**Arguments**

- `object`: a ADE-class object.
- `newdata`: data used to update the ADE model. This should be the data used to initially train the models (training set), together with new observations (for example, validation set). Each model is retrained using newdata.
- `num_cores`: A numeric value to specify the number of cores used to train base and meta models. `num_cores = 1` leads to sequential training of models. `num_cores > 1` splits the training of the base models across `num_cores` cores.

**See Also**

- ADE-class for building an ADE model; update_weights for updating the weights of the ensemble (without retraining the models); update_base_models for updating the base models of an ensemble; and update_ade_meta for updating the meta-models of an ADE model.

Other updating models: update_ade_meta(), update_weights()
Examples

```r
specs <- model_specs(
    learner = c("bm_svr", "bm_glm", "bm_mars"),
    learner_pars = NULL
)

data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
# toy size for checks
train <- dataset[,1:300,]
validation <- dataset[,301:400,]
test <- dataset[,401:500,]

model <- ADE(target ~., train, specs)
preds_val <- predict(model, validation)
model <- update_ade(model, rbind.data.frame(train, validation))
preds_test <- predict(model, test)
```

**update_ade_meta**

*Updating the metalearning layer of an ADE model*

Description

The `update_ade_meta` function uses new information to update the meta models of an `ADE-class` ensemble. As input it receives a `ADE-class` model object class and a new dataset for updating the weights of the base models in the ensemble. This new data should have the same structure as the one used to build the ensemble. Updating the base models of the ensemble is done using the `update_base_models` function.

Usage

```r
update_ade_meta(object, newdata, num_cores = 1)
```

## S4 method for signature 'ADE'

```r
update_ade_meta(object, newdata, num_cores = 1)
```

Arguments

- **object**
  - A `ADE-class` object.

- **newdata**
  - data used to update the meta models. This should be the data used to initially train the meta-models (training set), together with new observations (for example, validation set). Each meta model is retrained using `newdata`.

- **num_cores**
  - A numeric value to specify the number of cores used to train base and meta models. `num_cores = 1` leads to sequential training of models. `num_cores > 1` splits the training of the base models across `num_cores` cores.
See Also

ADE-class for building an ADE model; update_weights for updating the weights of the ensemble (without retraining the models); and update_base_models for updating the base models of an ensemble.

Other updating models: update_ade(), update_weights()

Examples

```r
## Not run:
specs <- model_specs(
  learner = c("bm_svr", "bm_glm", "bm_mars"),
  learner_pars = NULL
)

data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
train <- dataset[1:1000, ]
validation <- dataset[1001:1200, ]
test <- dataset[1201:1500, ]

model <- ADE(target ~., train, specs)
preds_val <- predict(model, validation)
model <- update_ade_meta(model, rbind.data.frame(train, validation))
preds_test <- predict(model, test)

## End(Not run)
```

update_base_models

Update the base models of an ensemble

Description

This is a generic function for updating the base models comprising an ensemble.

Usage

update_base_models(object, newdata, num_cores = 1)

## S4 method for signature 'ADE'
update_base_models(object, newdata, num_cores = 1)

## S4 method for signature 'DETS'
update_base_models(object, newdata, num_cores = 1)
**update_base_models**

**Arguments**

- **object**: an ensemble object, of class `DETS-class` or `ADE-class`;
- **newdata**: new data used to update the models. Each base model is retrained, so `newdata` should be the past data used for initially training the models along with any further available observations.
- **num_cores**: A numeric value to specify the number of cores used to train base and meta models. `num_cores = 1` leads to sequential training of models. `num_cores > 1` splits the training of the base models across `num_cores` cores.

**Details**

The **update_base_models** function receives a model object and a new dataset for retraining the base models. This new data should have the same structure as the one used to build the ensemble.

**See Also**

- `ADE-class` for the ADE model information, and `DETS-class` for the DETS model information;
- `update_ade_meta` for updating the meta models of an ADE ensemble. See `update_weights` for the method used to update the weights of the ensemble. Updating the weights only changes the information about the recent observations for computing the weights of the base models, while updating the model uses that information to retrain the models.

**Examples**

```r
data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)
# toy size for checks execution time
train <- dataset[1:300,]
test <- dataset[301:305,]
specs <- model_specs(c("bm_ppr","bm_glm","bm_mars"), NULL)
model <- ADE(target ~., train, specs)
predictions <- numeric(nrow(test))
for (i in seq_along(predictions)) {
  predictions[i] <- predict(model, test[i, ]@y_hat
  model <-
    update_base_models(model,
    rbind.data.frame(train, test[seq_len(i), ]))
}
###
specs2 <- model_specs(c("bm_ppr","bm_randomforest","bm_svr"), NULL)
modeldets <- DETS(target ~., train, specs2)
predictions <- numeric(nrow(test))
# predict new data and update models every three points
```

# in the remaining points, the only the weights are updated
for (i in seq_along(predictions)) {
  predictions[i] <- predict(modeldets, test[i, ]@y_hat
  if (i %% 3 == 0)
    modeldets <-
      update_base_models(modeldets,
      rbind.data.frame(train, test[seq_len(i), ]))
  else
    modeldets <- update_weights(modeldets, test[seq_len(i), ])
}

update_weights

## S4 method for signature 'ADE'
update_weights(object, newdata)

## S4 method for signature 'DETS'
update_weights(object, newdata)

Arguments

object  a `ADE-class` or `DETS-class` model object;
newdata new data used to update the most recent observations of the time series. At
          prediction time these observations are used to compute the weights of the base
          models

Note

Updating the weights of an ensemble is only necessary between different calls of the functions
predict or forecast. Otherwise, if consecutive know observations are predicted (e.g. a validation/test set) the updating is automatically done internally.

See Also

update_weights for the weight updating method for an `ADE` model, and update_weights for the
same method for a `DETS` model

Other updating models: update_ade_meta(), update_ade()
Examples

data("water_consumption")
dataset <- embed_timeseries(water_consumption, 5)

# toy size for checks
train <- dataset[1:300,]
test <- dataset[301:305,]

specs <- model_specs(c("bm_ppr","bm_glm","bm_mars"), NULL)
## same with model <- DETS(target ~., train, specs)
model <- ADE(target ~., train, specs)

# if consecutive know observations are predicted (e.g. a validation/test set)
# the updating is automatically done internally.
predictions1 <- predict(model, test}@y_hat

# otherwise, the models need to be updated
predictions <- numeric(nrow(test))
# predict new data and update the weights of the model
for (i in seq_along(predictions)) {
  predictions[i] <- predict(model, test[i, ]}@y_hat
  model <- update_weights(model, test[i, ])
}

#all.equal(predictions1, predictions)

water_consumption

Water Consumption in Oporto city (Portugal) area.

Description

A time series of classes xts and zoo containing the water consumption levels a specific delivery point at Oporto town, in Portugal.

Usage

water_consumption

Format

The time series has 1741 values from Jan, 2012 to Oct, 2016 in a daily granularity.

consumption consumption of water, raw value from sensor

Source

https://www.addp.pt/home.php
### xgb_optimizer

**Description**

XGB optimizer

**Usage**

```r
xgb_optimizer(X, y, gsearch)
```

**Arguments**

- **X**  
  Covariates
- **y**  
  Target values
- **gsearch**  
  Grid search

### xgb_predict_

**Description**

asdasd

**Usage**

```r
xgb_predict_(model, newdata)
```

**Arguments**

- **model**  
  mode
- **newdata**  
  s
Index

* datasets
  water_consumption, 23
* updating models
  update_ade, 18
  update_ade_meta, 19
  update_weights, 22
* weighting base models
  model_recent_performance, 10
  model_weighting, 13

ADE, 2, 22
base_ensemble, 5
bm_cubist, 11
bm_ffnn, 11
bm_gaussianprocess, 11
bm_gbm, 11
bm_glm, 11
bm_mars, 11
bm_pls_pcr, 12
bm_ppr, 11
bm_randomforest, 11
bm_svr, 11
build_base_ensemble, 5, 9
build_committee, 11, 14
cubist, 11

DETS, 6, 22
ever, 11
EMASE, 11, 14
embed, 8
embed_timeseries, 8
gausspr, 11
gbm, 11
get_top_models, 11, 14
glmnet, 11
ksvm, 11
learning_base_models, 9
meta_xgb_predict, 10
model_recent_performance, 10, 14
model_specs, 11
model_weighting, 11, 13
mvr, 12
nnet, 11
ppr, 11
predict, 4, 7, 14
predict, ADE-method (predict), 14
predict, base_ensemble-method (predict), 14
predict, DETS-method (predict), 14
predict.ade (predict), 14
predict.base (predict), 14
predict.dets (predict), 14
quickADE (ADE), 2
ranger, 11
select_best, 11, 14
tsensembler, 16
update_ade, 4, 18, 20, 22
update_ade, ADE-method (update_ade), 18
update_ade_meta, 4, 18, 19, 21, 22
update_ade_meta, ADE-method (update_ade_meta), 19
update_base_models, 4, 7, 16, 18–20, 20
update_base_models, ADE-method (update_base_models), 20
update_base_models, DETS-method (update_base_models), 20
update_weights, 4, 7, 16, 18, 20–22, 22
update_weights, ADE-method (update_weights), 22
update_weights, DETS-method (update_weights), 22
water_consumption, 23
xgb_optimizer, 24
xgb_predict_, 24