

# Package: ngboostForecast (via r-universe)

August 24, 2024

**Title** Probabilistic Time Series Forecasting

**Version** 0.1.1

**Description** Probabilistic time series forecasting via Natural Gradient Boosting for Probabilistic Prediction.

**License** Apache License (>= 2)

**URL** <https://github.com/Akai01/ngboostForecast>

**BugReports** <https://github.com/Akai01/ngboostForecast/issues>

**Encoding** UTF-8

**LazyData** true

**SystemRequirements** Python (>= 3.6)

**Roxygen** list(markdown = TRUE)

**RoxygenNote** 7.2.0

**Imports** dplyr (>= 1.0.7), forecast (>= 8.15), magrittr (>= 2.0.1), R6 (>= 2.5.1)

**Suggests** ggplot2 (>= 3.3.5), testthat (>= 3.0.0)

**Config/testthat/edition** 3

**Config/reticulate** list( packages = list( list(package = 'importlib-metadata', pip = TRUE), list(package = 'ngboost', pip = TRUE)) )

**Depends** R (>= 3.6), reticulate (>= 1.20)

**Repository** <https://akai01.r-universe.dev>

**RemoteUrl** <https://github.com/akai01/ngboostforecast>

**RemoteRef** HEAD

**RemoteSha** 08c92edd3ce5b7153b8ca7de253cba30d6056d98

## Contents

Dist . . . . .	2
is_exists_conda . . . . .	3
NGBforecast . . . . .	3
NGBforecastCV . . . . .	7
ngboostForecast . . . . .	10
Scores . . . . .	10
seatbelts . . . . .	11
sklearnr . . . . .	12
<b>Index</b>	<b>13</b>

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Dist	<i>NGBoost distributions</i>
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### Description

NGBoost distributions

### Usage

```
Dist(
  dist = c("Normal", "Bernoulli", "k_categorical", "StudentT", "Laplace", "Cauchy",
    "Exponential", "LogNormal", "MultivariateNormal", "Poisson"),
  k
)
```

### Arguments

dist	NGBoost distributions. One of the following: <ul style="list-style-type: none"> <li>• Bernoulli</li> <li>• k_categorical</li> <li>• StudentT</li> <li>• Poisson</li> <li>• Laplace</li> <li>• Cauchy</li> <li>• Exponential</li> <li>• LogNormal</li> <li>• MultivariateNormal</li> <li>• Normal</li> </ul>
k	Used only with k_categorical and MultivariateNormal

### Value

An NGBoost Distribution object

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is_exists_conda	<i>Is conda installed?</i>
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**Description**

Only for internal usage.

**Usage**

```
is_exists_conda()
```

**Value**

Logical, TRUE if conda is installed.

**Author(s)**

Resul Akay

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NGBforecast	<i>NGBboost forecasting class</i>
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**Description**

The main forecasting class.

**Value**

An NGBforecast class

**Methods****Public methods:**

- [NGBforecast\\$new\(\)](#)
- [NGBforecast\\$fit\(\)](#)
- [NGBforecast\\$forecast\(\)](#)
- [NGBforecast\\$feature\\_importances\(\)](#)
- [NGBforecast\\$plot\\_feature\\_importance\(\)](#)
- [NGBforecast\\$get\\_params\(\)](#)
- [NGBforecast\\$clone\(\)](#)

**Method** `new()`: Initialize an NGBforecast model.

*Usage:*

```

NGBforecast$new(
  Dist = NULL,
  Score = NULL,
  Base = NULL,
  natural_gradient = TRUE,
  n_estimators = as.integer(500),
  learning_rate = 0.01,
  minibatch_frac = 1,
  col_sample = 1,
  verbose = TRUE,
  verbose_eval = as.integer(100),
  tol = 1e-04,
  random_state = NULL
)

```

*Arguments:*

**Dist** Assumed distributional form of  $Y|X=x$ . An output of **Dist** function, e.g. `Dist('Normal')`

**Score** Rule to compare probabilistic predictions to the observed data. A score from **Scores** function, e.g. `Scores(score = "LogScore")`.

**Base** Base learner. An output of **sklearner** function, e.g. `sklearner(module = "tree", class = "DecisionTreeRegressor", ...)`

**natural\_gradient** Logical flag indicating whether the natural gradient should be used

**n\_estimators** The number of boosting iterations to fit

**learning\_rate** The learning rate

**minibatch\_frac** The percent subsample of rows to use in each boosting iteration

**col\_sample** The percent subsample of columns to use in each boosting iteration

**verbose** Flag indicating whether output should be printed during fitting. If TRUE it will print logs.

**verbose\_eval** Increment (in boosting iterations) at which output should be printed

**tol** Numerical tolerance to be used in optimization

**random\_state** Seed for reproducibility.

*Returns:* An NGBforecast object that can be fit.

**Method fit():** Fit the initialized model.

*Usage:*

```

NGBforecast$fit(
  y,
  max_lag = 5,
  xreg = NULL,
  test_size = NULL,
  seasonal = TRUE,
  K = frequency(y)/2 - 1,
  train_loss_monitor = NULL,
  val_loss_monitor = NULL,
  early_stopping_rounds = NULL
)

```

*Arguments:*

*y* A time series (ts) object  
*max\_lag* Maximum number of lags  
*xreg* Optional. A numerical matrix of external regressors, which must have the same number of rows as *y*.  
*test\_size* The length of validation set. If it is NULL, then, it is automatically specified.  
*seasonal* Boolean. If *seasonal* = TRUE the fourier terms will be used for modeling seasonality.  
*K* Maximum order(s) of Fourier terms, used only if *seasonal* = TRUE.  
*train\_loss\_monitor* A custom score or set of scores to track on the training set during training. Defaults to the score defined in the NGBBoost constructor. Please do not modify unless you know what you are doing.  
*val\_loss\_monitor* A custom score or set of scores to track on the validation set during training. Defaults to the score defined in the NGBBoost constructor. Please do not modify unless you know what you are doing.  
*early\_stopping\_rounds* The number of consecutive boosting iterations during which the loss has to increase before the algorithm stops early.

*Returns:* NULL

**Method** `forecast()`: Forecast the fitted model

*Usage:*

```
NGBforecast$forecast(h = 6, xreg = NULL, level = c(80, 95), data_frame = FALSE)
```

*Arguments:*

*h* Forecast horizon  
*xreg* A numerical vector or matrix of external regressors  
*level* Confidence level for prediction intervals  
*data\_frame* Bool. If TRUE, forecast will be returned as a data.frame object, if FALSE it will return a forecast class. If TRUE, `autoplot` will function.

**Method** `feature_importances()`: Return the feature importance for all parameters in the distribution (the higher, the more important the feature).

*Usage:*

```
NGBforecast$feature_importances()
```

*Returns:* A data frame

**Method** `plot_feature_importance()`: Plot feature importance

*Usage:*

```
NGBforecast$plot_feature_importance()
```

*Returns:* A ggplot object

**Method** `get_params()`: Get parameters for this estimator.

*Usage:*

```
NGBforecast$get_params(deep = TRUE)
```

*Arguments:*

`deep` bool, default = TRUE If True, will return the parameters for this estimator and contained subobjects that are estimators.

*Returns:* A named list of parameters.

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

*Usage:*

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

*Arguments:*

`deep` Whether to make a deep clone.

### Author(s)

Resul Akay

### References

Duan, T et. al. (2019), NGBoost: Natural Gradient Boosting for Probabilistic Prediction.

### Examples

```
## Not run:

library(ngboostForecast)

model <- NGBforecast$new(Dist = Dist("Normal"),
                        Base = sklearner(module = "linear_model",
                                        class = "Ridge"),
                        Score = Scores("LogScore"),
                        natural_gradient = TRUE,
                        n_estimators = 200,
                        learning_rate = 0.1,
                        minibatch_frac = 1,
                        col_sample = 1,
                        verbose = TRUE,
                        verbose_eval = 100,
                        tol = 1e-5)

model$fit(y = AirPassengers, seasonal = TRUE, max_lag = 12, xreg = NULL,
         early_stopping_rounds = 10L)
fc <- model$forecast(h = 12, level = c(90, 80), xreg = NULL)

autoplot(fc)

## End(Not run)
```

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NGBforecastCV	<i>NGBBoost forecasting model selection class</i>
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## Description

It is a wrapper for the sklearn GridSearchCV with TimeSeriesSplit.

## Methods

### Public methods:

- [NGBforecastCV\\$new\(\)](#)
- [NGBforecastCV\\$tune\(\)](#)
- [NGBforecastCV\\$clone\(\)](#)

**Method** `new()`: Initialize an NGBforecastCV model.

*Usage:*

```
NGBforecastCV$new(
  Dist = NULL,
  Score = NULL,
  Base = NULL,
  natural_gradient = TRUE,
  n_estimators = as.integer(500),
  learning_rate = 0.01,
  minibatch_frac = 1,
  col_sample = 1,
  verbose = TRUE,
  verbose_eval = as.integer(100),
  tol = 1e-04,
  random_state = NULL
)
```

*Arguments:*

`Dist` Assumed distributional form of  $Y|X=x$ . An output of `Dist` function, e.g. `Dist('Normal')`

`Score` Rule to compare probabilistic predictions to the observed data. A score from `Scores` function, e.g. `Scores(score = "LogScore")`.

`Base` Base learner. An output of `sklearner` function, e.g. `sklearner(module = "tree", class = "DecisionTreeRegressor", ...)`

`natural_gradient` Logical flag indicating whether the natural gradient should be used

`n_estimators` The number of boosting iterations to fit

`learning_rate` The learning rate

`minibatch_frac` The percent subsample of rows to use in each boosting iteration

`col_sample` The percent subsample of columns to use in each boosting iteration

`verbose` Flag indicating whether output should be printed during fitting. If TRUE it will print logs.

`verbose_eval` Increment (in boosting iterations) at which output should be printed

tol Numerical tolerance to be used in optimization  
 random\_state Seed for reproducibility.

*Returns:* An NGBforecastCV object that can be fit.

**Method** tune(): Tune ngboosForecast.

*Usage:*

```
NGBforecastCV$tune(
  y,
  max_lag = 5,
  xreg = NULL,
  seasonal = TRUE,
  K = frequency(y)/2 - 1,
  n_splits = NULL,
  train_loss_monitor = NULL,
  val_loss_monitor = NULL,
  early_stopping_rounds = NULL
)
```

*Arguments:*

y A time series (ts) object

max\_lag Maximum number of lags

xreg Optional. A numerical matrix of external regressors, which must have the same number of rows as y.

seasonal Boolean. If seasonal = TRUE the fourier terms will be used for modeling seasonality.

K Maximum order(s) of Fourier terms, used only if seasonal = TRUE.

n\_splits Number of splits. Must be at least 2.

train\_loss\_monitor A custom score or set of scores to track on the training set during training. Defaults to the score defined in the NGBBoost constructor. Please do not modify unless you know what you are doing.

val\_loss\_monitor A custom score or set of scores to track on the validation set during training. Defaults to the score defined in the NGBBoost constructor. Please do not modify unless you know what you are doing.

early\_stopping\_rounds The number of consecutive boosting iterations during which the loss has to increase before the algorithm stops early.

test\_size The length of validation set. If it is NULL, then, it is automatically specified.

*Returns:* A named list of best parameters.

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

*Usage:*

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

*Arguments:*

deep Whether to make a deep clone.

**Author(s)**

Resul Akay



## References

<https://stanfordmlgroup.github.io/ngboost/2-tuning.html>

## Examples

```
## Not run:

library(ngboostForecast)

dists <- list(Dist("Normal"))

base_learners <- list(sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 1),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 2),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 3),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 4),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 5),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 6),
                    sklearner(module = "tree", class = "DecisionTreeRegressor",
                               max_depth = 7))

scores <- list(Scores("LogScore"))

model <- NGBforecastCV$new(Dist = dists,
                          Base = base_learners,
                          Score = scores,
                          natural_gradient = TRUE,
                          n_estimators = list(10, 100),
                          learning_rate = list(0.1, 0.2),
                          minibatch_frac = list(0.1, 1),
                          col_sample = list(0.3),
                          verbose = FALSE,
                          verbose_eval = 100,
                          tol = 1e-5)

params <- model$tune(y = AirPassengers,
                   seasonal = TRUE,
                   max_lag = 12,
                   xreg = NULL,
                   early_stopping_rounds = NULL,
                   n_splits = 4L)

params

## End(Not run)
```

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ngboostForecast	<i>Probabilistic Time Series Forecasting</i>
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**Description**

Probabilistic time series forecasting via Natural Gradient Boosting for Probabilistic Prediction.

**References**

Duan, T et. al. (2019), NGBoost: Natural Gradient Boosting for Probabilistic Prediction.

**Examples**

```
## Not run:

library(ngboostForecast)

model <- NGBforecast$new(Dist = Dist("Normal"),
                        Base = sklearner(module = "linear_model",
                                          class = "Ridge"),
                        Score = Scores("LogScore"),
                        natural_gradient = TRUE,
                        n_estimators = 200,
                        learning_rate = 0.1,
                        minibatch_frac = 1,
                        col_sample = 1,
                        verbose = TRUE,
                        verbose_eval = 100,
                        tol = 1e-5)

model$fit(y = AirPassengers, seasonal = TRUE, max_lag = 12, xreg = NULL,
         early_stopping_rounds = 10L)

fc <- model$forecast(h = 12, level = c(90, 80), xreg = NULL)

autoplot(fc)

## End(Not run)
```

---

Scores	<i>Select a rule to compare probabilistic predictions to the observed data.</i>
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**Description**

Select a rule to compare probabilistic predictions to the observed data. A score from `ngboost.scores`, e.g. `LogScore`.

**Usage**

```
Scores(score = c("LogScore", "CRPS", "CRPScore", "MLE"))
```

**Arguments**

score            A string. can be one of the following:

- LogScore : Generic class for the log scoring rule.
- CRPS : Generic class for the continuous ranked probability scoring rule.
- CRPScore : Generic class for the continuous ranked probability scoring rule.
- MLE : Generic class for the log scoring rule.

**Value**

A score class from `ngboost.scores`

**Author(s)**

Resul Akay

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seatbelts

*Road Casualties in Great Britain 1969-84*

---

**Description**

The Seatbelts dataset from the `datasets` package.

**Usage**

```
seatbelts
```

**Format**

An object of class `mts` (inherits from `ts`) with 192 rows and 8 columns.

**Source**

Harvey, A.C. (1989). *Forecasting, Structural Time Series Models and the Kalman Filter*. Cambridge University Press, pp. 519–523.

Durbin, J. and Koopman, S. J. (2001). *Time Series Analysis by State Space Methods*. Oxford University Press.

<https://stat.ethz.ch/R-manual/R-devel/library/datasets/html/UKDriverDeaths.html>

**References**

Harvey, A. C. and Durbin, J. (1986). The effects of seat belt legislation on British road casualties: A case study in structural time series modelling. *Journal of the Royal Statistical Society series A*, 149, 187–227.

---

sklearner

*Scikit-Learn interface*

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### **Description**

Scikit-Learn interface

### **Usage**

```
sklearner(module = "tree", class = "DecisionTreeRegressor", ...)
```

### **Arguments**

module	scikit-learn module name, default is 'tree'.
class	scikit-learn's module class, default is 'DecisionTreeRegressor'
...	Other arguments passed to model class

### **Author(s)**

Resul Akay

### **Examples**

```
## Not run:  
  
sklearner(module = "tree", class = "DecisionTreeRegressor",  
criterion="friedman_mse", min_samples_split=2)  
  
## End(Not run)
```

# Index

## \* datasets

seatbelts, 11

autoplot, 5

Dist, 2, 4, 7

is\_exists\_conda, 3

NGBforecast, 3

NGBforecastCV, 7

ngboostForecast, 10

Scores, 4, 7, 10

seatbelts, 11

sklearner, 4, 7, 12