

# Package: Bodi (via r-universe)

September 15, 2024

**Title** Boosting Diversity in Regression Ensembles

**Version** 0.1.0

**Description** A gradient boosting-based algorithm by incorporating a diversity term to guide the gradient boosting iterations, see Bourel, Cugliari, Goude, Poggi (2021) [<https://hal.archives-ouvertes.fr/hal-03041309/>](https://hal.archives-ouvertes.fr/hal-03041309/).

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**Repository** <https://yannig29.r-universe.dev>

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Bodi-package

*Bodi: Boosting Diversity Algorithm*

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### Description

We provide an implementation of the boosting diversity algorithm. This is a gradient boosting-based algorithm by incorporating a diversity term to guide the gradient boosting iterations. The idea is to trade off some individual optimality for global enhancement. The improvement is obtained with progressively generated predictors by boosting diversity. See Borel et al. (2021) <<https://hal.archives-ouvertes.fr/hal-03041309v1>>

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### References

- Mathias Bourel, Jairo Cugliari, Yannig Goude, Jean-Michel Poggi. Boosting Diversity in Regression Ensembles. <https://hal.archives-ouvertes.fr/hal-03041309v1> (2021).

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boosting\_diversity

*Diversity Boosting Algorithm*

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### Description

Train a set of initial learners by promoting diversity among them. For this, a gradient descent strategy is adopted where a specialized loss function induces diversity which yields on a reduction of the mean-square-error of the aggregated learner.

### Usage

```
boosting_diversity(  
  target,  
  cov,  
  data0,  
  data1,  
  sample_size = 0.5,  
  grad_step = 1,  
  diversity_weight = 1,  
  Nstep = 10,  
  model = "gam",  
  sampling = "random",  
  Nblock = 10,
```

```

    aggregation_type = "uniform",
    param = list(),
    theoretical_dw = FALSE,
    model_list = NULL,
    w_list = NULL,
    param_list = NULL,
    cov_list = NULL
)

```

## Arguments

target	name of the target variable
cov	the model equation, a character string provided in the formula syntax. For example, for a linear model including covariates $X_1$ and $X_2$ it will be " $X_1+X_2$ " and for a GAM with smooth effects it will be " $s(X_1)+s(X_2)$ "
data0	the learning set
data1	the test set
sample_size	the size of the bootstrap sample as a proportion of the learning set size. <code>sample_size=0.5</code> means that the resamples are of size $n/2$ where $n$ is the number of rows of <code>data0</code> .
grad_step	step of the gradient descent
diversity_weight	the weight of the diversity encouraging penalty ( $\kappa$ in the paper)
Nstep	the number of iterations of the diversity boosting algorithm ( $N$ in the paper)
model	the type of base learner used in the algorithm if using a single base learner ( <code>model_list=NULL</code> ). Currently it could be either "gam" for an additive model, "rf" for a random forest, "gbm" for gradient boosting machines, "rpart" for single CART trees.
sampling	the type of sampling procedure used in the resampling step. Could be either "random" for uniform random sampling with replacement or "blocks" for uniform sampling with replacement of blocks of consecutive data points. Default is "random".
Nblock	number of blocks for the block sampling. Equal to 10 by default.
aggregation_type	type of aggregation used for the ensemble method, default is uniform weights but it could be also "MLpol" an aggregation algorithm from the <code>opera</code> package
param	a list containing the parameters of the model chosen. It could be e.g. the number of trees for "rf", the depth of the tree for "rpart"...
theoretical_dw	set to TRUE if one want to use the theoretical upper bound of the diversity weight $\kappa$
model_list	a list of model among the possible ones (see the description of model argument). In that case the weak learner is sample at each step in the list. "Still "experimental", be careful.
w_list	the prior weights of each model in the <code>model_list</code>
param_list	list of parameters of each model in the <code>model_list</code>
cov_list	list of covariates of each model in the <code>model_list</code>

**Value**

a list including the boosted models, the ensemble forecast

fitted_ensemble	Fitted values (in-sample predictions) for the ensemble method (matrix).
forecast_ensemble	Forecast (out-sample predictions) for the ensemble method (matrix).
fitted	Fitted values of the last boosting iteration (vector).
forecast	Forecast of the last boosting iteration (vector).
err_oob	Estimated out-of-bag errors by iteration (vector).
diversiy_oob	Estimated out-of-bag diversity (vector).

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**Examples**

```
all <- na.omit(airquality)
smp <- sample(nrow(all), floor(.8 * nrow(all)))
boosting_diversity("Ozone", "Solar.R+Wind+Temp+Month+Day",
                  data0 = all[smp, ], data1 = all[-smp, ])
```

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buildBlock

*buildBlock*

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**Description**

Compute blocks of consecutive data for blockwise CV or sampling.

**Usage**

```
buildBlock(Nblock, data0)
```

**Arguments**

Nblock	number of blocks
data0	the learning set

**Value**

A list of vectors containing the indices of each block.

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**Examples**

```
buildBlock(4, data.frame(id = 1:15))
```

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