

Package ‘measures’

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Title Performance Measures for Statistical Learning

Version 0.3

Description Provides the biggest amount of statistical measures in the whole R world. Includes measures of regression, (multiclass) classification and multilabel classification. The measures come mainly from the 'mlr' package and were programmed by several 'mlr' developers.

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License GPL-3

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ACC	<i>Accuracy</i>
-----	-----------------

Description

Defined as: `mean(response == truth)`

Usage

```
ACC(truth, response)
```

Arguments

truth	vector of true values
response	vector of predicted values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
response = as.factor(sample(c(1,2,3), n, replace = TRUE))
ACC(truth, response)
```

ARSQ	<i>Adjusted coefficient of determination</i>
------	--

Description

Defined as: $1 - (1 - \text{rsq}) * (p / (n - p - 1L))$. Adjusted R-squared is only defined for normal linear regression.

Usage

```
ARSQ(truth, response, n, p)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values
n	[numeric] number of observations
p	[numeric] number of predictors

Examples

```
n = 20
p = 5
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
ARSQ(truth, response, n, p)
```

AUC

Area under the curve

Description

Integral over the graph that results from computing fpr and tpr for many different thresholds.

Usage

```
AUC(probabilities, truth, negative, positive)
```

Arguments

probabilities	[numeric] vector of predicted probabilities
truth	vector of true values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
AUC(probabilities, truth, negative, positive)
```

BAC	<i>Balanced accuracy</i>
-----	--------------------------

Description

Mean of true positive rate and true negative rate.

Usage

```
BAC(truth, response, negative, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
BAC(truth, response, negative, positive)
```

BER	<i>Balanced error rate</i>
-----	----------------------------

Description

Mean of misclassification error rates on all individual classes.

Usage

```
BER(truth, response)
```

Arguments

truth	vector of true values
response	vector of predicted values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
response = as.factor(sample(c(1,2,3), n, replace = TRUE))
BER(truth, response)
```

 Brier

Brier score

Description

The Brier score is defined as the quadratic difference between the probability and the value (1,0) for the class. That means we use the numeric representation 1 and 0 for our target classes. It is similar to the mean squared error in regression. `multiclass.brier` is the sum over all one vs. all comparisons and for a binary classification $2 * \text{brier}$.

Usage

```
Brier(probabilities, truth, negative, positive)
```

Arguments

<code>probabilities</code>	[numeric] vector of predicted probabilities
<code>truth</code>	vector of true values
<code>negative</code>	negative class
<code>positive</code>	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
Brier(probabilities, truth, negative, positive)
```

BrierScaled	<i>Brier scaled</i>
-------------	---------------------

Description

Brier score scaled to [0,1], see <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3575184/>.

Usage

```
BrierScaled(probabilities, truth, negative, positive)
```

Arguments

probabilities	[numeric] vector of predicted probabilities
truth	vector of true values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
BrierScaled(probabilities, truth, negative, positive)
```

EXPVAR	<i>Explained variance</i>
--------	---------------------------

Description

Similar to RSQ (R-squared). Defined as $\text{explained_sum_of_squares} / \text{total_sum_of_squares}$.

Usage

```
EXPVAR(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
EXPVAR(truth, response)
```

F1 *F1 measure*

Description

Defined as: $2 * tp / (\text{sum}(\text{truth} == \text{positive}) + \text{sum}(\text{response} == \text{positive}))$

Usage

```
F1(truth, response, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
F1(truth, response, positive)
```

FDR *False discovery rate*

Description

Defined as: $fp / (tp + fp)$

Usage

```
FDR(truth, response, positive)
```


Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
FDR(truth, response, positive)
```

FN	<i>False negatives</i>
----	------------------------

Description

Sum of misclassified observations in the negative class. Also called misses.

Usage

```
FN(truth, response, negative)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
negative = 0
FN(truth, response, negative)
```

FNR *False negative rate*

Description

Percentage of misclassified observations in the negative class.

Usage

```
FNR(truth, response, negative, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
FNR(truth, response, negative, positive)
```

FP *False positives*

Description

Sum of misclassified observations in the positive class. Also called false alarms.

Usage

```
FP(truth, response, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
FPR(truth, response, positive)
```

FPR

False positive rate

Description

Percentage of misclassified observations in the positive class. Also called false alarm rate or fall-out.

Usage

```
FPR(truth, response, negative, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
FPR(truth, response, negative, positive)
```

GMEAN

G-mean

Description

Geometric mean of recall and specificity.

Usage

```
GMEAN(truth, response, negative, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class
positive	positive class

References

He, H. & Garcia, E. A. (2009) *Learning from Imbalanced Data.* IEEE Transactions on Knowledge and Data Engineering, vol. 21, no. 9. pp. 1263-1284.

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
GMEAN(truth, response, negative, positive)
```

GPR*Geometric mean of precision and recall.*

Description

Defined as: $\sqrt{\text{ppv} * \text{tpr}}$

Usage

```
GPR(truth, response, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
GPR(truth, response, positive)
```

KAPPA	<i>Cohen's kappa</i>
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Description

Defined as: $1 - (1 - p_0) / (1 - p_e)$. With: p_0 = 'observed frequency of agreement' and p_e = 'expected agreement frequency under independence'

Usage

```
KAPPA(truth, response)
```

Arguments

truth	vector of true values
response	vector of predicted values <code>n = 20 set.seed(122) truth = as.factor(sample(c(1,2,3), n, replace = TRUE)) response = as.factor(sample(c(1,2,3), n, repla</code> KAPPA(truth, response)

KendallTau	<i>Kendall's tau</i>
------------	----------------------

Description

Defined as: Kendall's tau correlation between truth and response. Only looks at the order. See Rosset et al.: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.1398&rep=rep1&type=pdf>.

Usage

```
KendallTau(truth, response)
```

Arguments

truth [numeric] vector of true values
 response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
KendallTau(truth, response)
```

listAllMeasures	<i>List all measures</i>
-----------------	--------------------------

Description

Lists all measures that are available in the package with their corresponding task.

Usage

```
listAllMeasures()
```

Value

Dataframe with all available measures and the corresponding task

Examples

```
listAllMeasures()
```

Logloss	<i>Logarithmic loss</i>
---------	-------------------------

Description

Defined as: $-\text{mean}(\log(p_i))$, where p_i is the predicted probability of the true class of observation i . Inspired by <https://www.kaggle.com/wiki/MultiClassLogLoss>.

Usage

```
Logloss(probabilities, truth)
```

Arguments

probabilities	[numeric] vector (or matrix with column names of the classes) of predicted probabilities
truth	vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
Logloss(probabilities, truth)
```

LSR

Logarithmic Scoring Rule

Description

Defined as: $\text{mean}(\log(p_i))$, where p_i is the predicted probability of the true class of observation i . This scoring rule is the same as the negative logloss, self-information or surprisal. See: Bickel, J. E. (2007). Some comparisons among quadratic, spherical, and logarithmic scoring rules. *Decision Analysis*, 4(2), 49-65.

Usage

```
LSR(probabilities, truth)
```

Arguments

probabilities	[numeric] vector (or matrix with column names of the classes) of predicted probabilities
truth	vector of true values <code>n = 20 set.seed(122) truth = as.factor(sample(c(1,2,3), n, replace = TRUE)) probabilities = matrix(runif(60), 20, 3) probabilities = probabilities/rowSums(probabilities) colnames(probabilities) = c(1,2,3) LSR(probabilities, truth)</code>

MAE	<i>Mean of absolute errors</i>
-----	--------------------------------

Description

Defined as: `mean(abs(response - truth))`

Usage

```
MAE(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
MAE(truth, response)
```

MAPE	<i>Mean absolute percentage error</i>
------	---------------------------------------

Description

Defined as the `abs(truth_i - response_i) / truth_i`. Won't work if any truth value is equal to zero. In this case the output will be NA.

Usage

```
MAPE(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
MAPE(truth, response)
```

MCC

Matthews correlation coefficient

Description

Defined as $(tp * tn - fp * fn) / \sqrt{(tp + fp) * (tp + fn) * (tn + fp) * (tn + fn)}$, denominator set to 1 if 0.

Usage

```
MCC(truth, response, negative, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
negative = 0
MCC(truth, response, negative, positive)
```

MEDAE

Median of absolute errors

Description

Defined as: `median(abs(response - truth))`.

Usage

```
MEDAE(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
MEDAE(truth, response)
```

MEDSE

Median of squared errors

Description

Defined as: $\text{median}((\text{response} - \text{truth})^2)$.

Usage

```
MEDSE(truth, response)
```

Arguments

truth [numeric] vector of true values
response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
MEDSE(truth, response)
```

MMCE

Mean misclassification error

Description

Defined as: $\text{mean}(\text{response} \neq \text{truth})$

Usage

```
MMCE(truth, response)
```

Arguments

truth vector of true values
response vector of predicted values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
response = as.factor(sample(c(1,2,3), n, replace = TRUE))
MMCE(truth, response)
```

MSE

Mean of squared errors

Description

Defined as: $\text{mean}((\text{response} - \text{truth})^2)$

Usage

```
MSE(truth, response)
```

Arguments

truth [numeric] vector of true values
response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
MSE(truth, response)
```

MSLE

Mean squared logarithmic error

Description

Defined as: $\text{mean}((\log(\text{response} + 1, \text{exp}(1)) - \log(\text{truth} + 1, \text{exp}(1)))^2)$. This is mostly used for count data, note that all predicted and actual target values must be greater or equal '-1' to compute the mean squared logarithmic error.

Usage

```
MSLE(truth, response)
```

Arguments

truth [numeric] vector of true values
 response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = abs(rnorm(n))
response = abs(rnorm(n))
MSLE(truth, response)
```

multiclass.AU1P *Weighted average 1 vs. 1 multiclass AUC*

Description

Computes AUC of $c(c - 1)$ binary classifiers while considering the a priori distribution of the classes. See Ferri et al.: <https://www.math.ucdavis.edu/~saito/data/roc/ferri-class-perf-metrics.pdf>.

Usage

```
multiclass.AU1P(probabilities, truth)
```

Arguments

probabilities [numeric] matrix of predicted probabilities with columnnames of the classes
 truth vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
multiclass.AU1P(probabilities, truth)
```

multiclass.AU1U	<i>Average 1 vs. 1 multiclass AUC</i>
-----------------	---------------------------------------

Description

Computes AUC of $c(c - 1)$ binary classifiers (all possible pairwise combinations) while considering uniform distribution of the classes. See Ferri et al.: <https://www.math.ucdavis.edu/~saito/data/roc/ferri-class-perf-metrics.pdf>.

Usage

```
multiclass.AU1U(probabilities, truth)
```

Arguments

probabilities [numeric] matrix of predicted probabilities with columnnames of the classes
truth vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
multiclass.AU1U(probabilities, truth)
```

multiclass.AUNP	<i>Weighted average 1 vs. rest multiclass AUC</i>
-----------------	---

Description

Computes the AUC treating a c -dimensional classifier as c two-dimensional classifiers, taking into account the prior probability of each class. See Ferri et al.: <https://www.math.ucdavis.edu/~saito/data/roc/ferri-class-perf-metrics.pdf>.

Usage

```
multiclass.AUNP(probabilities, truth)
```

Arguments

probabilities [numeric] matrix of predicted probabilities with columnnames of the classes
truth vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
multiclass.AUNP(probabilities, truth)
```

multiclass.AUNU

Average 1 vs. rest multiclass AUC

Description

Computes the AUC treating a c-dimensional classifier as c two-dimensional classifiers, where classes are assumed to have uniform distribution, in order to have a measure which is independent of class distribution change. See Ferri et al.: <https://www.math.ucdavis.edu/~saito/data/roc/ferri-class-perf-metrics.pdf>.

Usage

```
multiclass.AUNU(probabilities, truth)
```

Arguments

`probabilities` [numeric] matrix of predicted probabilities with columnnames of the classes
`truth` vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
multiclass.AUNU(probabilities, truth)
```

multiclass.Brier	<i>Multiclass Brier score</i>
------------------	-------------------------------

Description

Defined as: $(1/n) \sum_i \sum_j (y_{ij} - p_{ij})^2$, where $y_{ij} = 1$ if observation i has class j (else 0), and p_{ij} is the predicted probability of observation i for class j . From <http://docs.lib.noaa.gov/rescue/mwr/078/mwr-078-01-0001.pdf>.

Usage

```
multiclass.Brier(probabilities, truth)
```

Arguments

probabilities	[numeric] matrix of predicted probabilities with columnnames of the classes
truth	vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
multiclass.Brier(probabilities, truth)
```

MultilabelACC	<i>Accuracy (multilabel)</i>
---------------	------------------------------

Description

Averaged proportion of correctly predicted labels with respect to the total number of labels for each instance, following the definition by Charte and Charte: <https://journal.r-project.org/archive/2015-2/charte-chart.pdf>. Fractions where the denominator becomes 0 are replaced with 1 before computing the average across all instances.

Usage

```
MultilabelACC(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values <code>n = 20</code> <code>set.seed(122)</code> <code>truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)</code> <code>response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)</code> <code>MultilabelACC(truth, response)</code>

MultilabelF1 *F1 measure (multilabel)*

Description

Harmonic mean of precision and recall on a per instance basis (Micro-F1), following the definition by Montanes et al.: <http://www.sciencedirect.com/science/article/pii/S0031320313004019>. Fractions where the denominator becomes 0 are replaced with 1 before computing the average across all instances.

Usage

```
MultilabelF1(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values n = 20 set.seed(122) truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3) response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3) MultilabelF1(truth, response)

MultilabelHamloss *Hamming loss*

Description

Proportion of labels that are predicted incorrectly, following the definition by Charte and Charte: <https://journal.r-project.org/archive/2015-2/charte-charte.pdf>.

Usage

```
MultilabelHamloss(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values

Examples

```
n = 20
set.seed(122)
truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
MultilabelHamloss(truth, response)
```

MultilabelPPV	<i>Positive predictive value (multilabel)</i>
---------------	---

Description

Also called precision. Averaged ratio of correctly predicted labels for each instance, following the definition by Charte and Charte: <https://journal.r-project.org/archive/2015-2/charte-chart.pdf>. Fractions where the denominator becomes 0 are ignored in the average calculation.

Usage

```
MultilabelPPV(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values n = 20 set.seed(122) truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3) response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3) MultilabelPPV(truth, response)

MultilabelSubset01	<i>Subset-0-1 loss</i>
--------------------	------------------------

Description

Proportion of observations where the complete multilabel set (all 0-1-labels) is predicted incorrectly, following the definition by Charte and Charte: <https://journal.r-project.org/archive/2015-2/charte-chart.pdf>.

Usage

```
MultilabelSubset01(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values

Examples

```
n = 20
set.seed(122)
truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
MultilabelSubset01(truth, response)
```

MultilabelTPR	<i>TPR (multilabel)</i>
---------------	-------------------------

Description

Also called recall. Averaged proportion of predicted labels which are relevant for each instance, following the definition by Charte and Charte: <https://journal.r-project.org/archive/2015-2/charte-charte.pdf>. Fractions where the denominator becomes 0 are ignored in the average calculation.

Usage

```
MultilabelTPR(truth, response)
```

Arguments

truth	matrix of true values
response	matrix of predicted values

```
n = 20 set.seed(122) truth = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
response = matrix(sample(c(0,1), 60, replace = TRUE), 20, 3)
MultilabelTPR(truth, response)
```

NPV	<i>Negative predictive value</i>
-----	----------------------------------

Description

Defined as: $tn / (tn + fn)$.

Usage

```
NPV(truth, response, negative)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
negative = 0
NPV(truth, response, negative)
```

PPV *Positive predictive value*

Description

Defined as: $tp / (tp + fp)$. Also called precision. If the denominator is 0, PPV is set to be either 1 or 0 depending on whether the highest probability prediction is positive (1) or negative (0).

Usage

```
PPV(truth, response, positive, probabilities = NULL)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class
probabilities	[numeric] vector of predicted probabilities

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
PPV(truth, response, positive, probabilities = NULL)
```

QSR *Quadratic Scoring Rule*

Description

Defined as: $1 - (1/n) \sum_i \sum_j (y_{ij} - p_{ij})^2$, where $y_{ij} = 1$ if observation i has class j (else 0), and p_{ij} is the predicted probability of observation i for class j . This scoring rule is the same as $1 - \text{multiclass.brier}$. See: Bickel, J. E. (2007). Some comparisons among quadratic, spherical, and logarithmic scoring rules. *Decision Analysis*, 4(2), 49-65.

Usage

```
QSR(probabilities, truth)
```

Arguments

probabilities [numeric] vector (or matrix with column names of the classes) of predicted probabilities

truth vector of true values `n = 20` `set.seed(122)` `truth = as.factor(sample(c(1,2,3), n, replace = TRUE))` `probabilities = matrix(runif(60), 20, 3)` `probabilities = probabilities/rowSums(probabilities)` `colnames(probabilities) = c(1,2,3)` `QSR(probabilities, truth)`

RAE

*Relative absolute error***Description**

Defined as `sum_of_absolute_errors / mean_absolute_deviation`. Undefined for single instances and when every truth value is identical. In this case the output will be NA.

Usage

```
RAE(truth, response)
```

Arguments

truth [numeric] vector of true values

response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
RAE(truth, response)
```

RMSE

*Root mean squared error***Description**

The RMSE is aggregated as `sqrt(mean(rmse.vals.on.test.sets^2))`

Usage

```
RMSE(truth, response)
```

Arguments

truth [numeric] vector of true values
response [numeric] vector of predicted values

Examples

```
n = 20  
set.seed(123)  
truth = rnorm(n)  
response = rnorm(n)  
RMSE(truth, response)
```

RMSLE

Root mean squared logarithmic error

Description

Definition taken from: <https://www.kaggle.com/wiki/RootMeanSquaredLogarithmicError>. This is mostly used for count data, note that all predicted and actual target values must be greater or equal '-1' to compute the root mean squared logarithmic error.

Usage

```
RMSLE(truth, response)
```

Arguments

truth [numeric] vector of true values
response [numeric] vector of predicted values

Examples

```
n = 20  
set.seed(123)  
truth = abs(rnorm(n))  
response = abs(rnorm(n))  
RMSLE(truth, response)
```

RRSE	<i>Root relative squared error</i>
------	------------------------------------

Description

Defined as $\sqrt{\text{sum_of_squared_errors} / \text{total_sum_of_squares}}$. Undefined for single instances and when every truth value is identical. In this case the output will be NA.

Usage

```
RRSE(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
RRSE(truth, response)
```

RSQ	<i>Coefficient of determination</i>
-----	-------------------------------------

Description

Also called R-squared, which is $1 - \text{residual_sum_of_squares} / \text{total_sum_of_squares}$.

Usage

```
RSQ(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
RSQ(truth, response)
```

SAE	<i>Sum of absolute errors</i>
-----	-------------------------------

Description

Defined as: `sum(abs(response - truth))`"

Usage

```
SAE(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
SAE(truth, response)
```

SpearmanRho	<i>Spearman's rho</i>
-------------	-----------------------

Description

Defined as: Spearman's rho correlation between truth and response. Only looks at the order. See Rosset et al.: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.95.1398&rep=rep1&type=pdf>.

Usage

```
SpearmanRho(truth, response)
```

Arguments

truth	[numeric] vector of true values
response	[numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
SpearmanRho(truth, response)
```

SSE *Sum of squared errors*

Description

Defined as: $\text{sum}((\text{response} - \text{truth})^2)$

Usage

SSE(truth, response)

Arguments

truth [numeric] vector of true values
 response [numeric] vector of predicted values

Examples

```
n = 20
set.seed(123)
truth = rnorm(n)
response = rnorm(n)
SSE(truth, response)
```

SSR *Spherical Scoring Rule*

Description

Defined as: $\text{mean}(p_i(\sum_j(p_{ij})))$, where p_i is the predicted probability of the true class of observation i and p_{ij} is the predicted probability of observation i for class j . See: Bickel, J. E. (2007). Some comparisons among quadratic, spherical, and logarithmic scoring rules. *Decision Analysis*, 4(2), 49-65.

Usage

SSR(probabilities, truth)

Arguments

probabilities [numeric] vector (or matrix with column names of the classes) of predicted probabilities
 truth vector of true values

Examples

```
n = 20
set.seed(122)
truth = as.factor(sample(c(1,2,3), n, replace = TRUE))
probabilities = matrix(runif(60), 20, 3)
probabilities = probabilities/rowSums(probabilities)
colnames(probabilities) = c(1,2,3)
SSR(probabilities, truth)
```

TN	<i>True negatives</i>
----	-----------------------

Description

Sum of correctly classified observations in the negative class. Also called correct rejections.

Usage

```
TN(truth, response, negative)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
negative = 0
TN(truth, response, negative)
```

TNR	<i>True negative rate</i>
-----	---------------------------

Description

Percentage of correctly classified observations in the negative class. Also called specificity.

Usage

```
TNR(truth, response, negative)
```

Arguments

truth	vector of true values
response	vector of predicted values
negative	negative class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
negative = 0
TPR(truth, response, negative)
```

TP	<i>True positives</i>
----	-----------------------

Description

Sum of all correctly classified observations in the positive class.

Usage

```
TP(truth, response, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
TP(truth, response, positive)
```

TPR	<i>True positive rate</i>
-----	---------------------------

Description

Percentage of correctly classified observations in the positive class. Also called hit rate or recall or sensitivity.

Usage

```
TPR(truth, response, positive)
```

Arguments

truth	vector of true values
response	vector of predicted values
positive	positive class

Examples

```
n = 20
set.seed(125)
truth = as.factor(sample(c(1,0), n, replace = TRUE))
probabilities = runif(n)
response = as.factor(as.numeric(probabilities > 0.5))
positive = 1
TPR(truth, response, positive)
```

WKAPPA	<i>Mean quadratic weighted kappa</i>
--------	--------------------------------------

Description

Defined as: $1 - \frac{\sum(\text{weights} * \text{conf.mat})}{\sum(\text{weights} * \text{expected.mat})}$, the weight matrix measures seriousness of disagreement with the squared euclidean metric.

Usage

```
WKAPPA(truth, response)
```

Arguments

truth	vector of true values
response	vector of predicted values n = 20 set.seed(122) truth = as.factor(sample(c(1,2,3), n, replace = TRUE)) response = as.factor(sample(c(1,2,3), n, repla WKAPPA(truth, response)

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