

Package ‘amelie’

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Type Package

Title Anomaly Detection with Normal Probability Functions

Version 0.2.1

Description Implements anomaly detection as binary classification for cross-sectional data. Uses maximum likelihood estimates and normal probability functions to classify observations as anomalous. The method is presented in the following lecture from the Machine Learning course by Andrew Ng: <<https://www.coursera.org/learn/machine-learning/lecture/C8IJp/algorithm/>>, and is also described in: Aleksandar Lazarevic, Levent Ertoz, Vipin Kumar, Aysel Ozgur, Jaideep Srivastava (2003) <[doi:10.1137/1.9781611972733.3](https://doi.org/10.1137/1.9781611972733.3)>.

Imports stats

License GPL (>= 3)

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ad *ad: anomaly detection with normal probability density functions.*

Description

ad: anomaly detection with normal probability density functions.

Usage

```
ad(x, ...)

## S3 method for class 'formula'
ad(formula, data, na.action = na.omit, ...)

## Default S3 method:
ad(x, y, univariate = TRUE, score = "f1",
   steps = 1000, ...)

## S3 method for class 'ad'
print(x, ...)
```

Arguments

x	A matrix of numeric features.
...	Optional parameters to be passed to ad.default.
formula	An object of class "formula": a symbolic description of the model to be fitted.
data	A data frame containing the features (predictors) and target.
na.action	A function specifying the action to be taken if NAs are found.
y	A vector of numeric target values, either 0 or 1, with 1 assumed to be anomalous.
univariate	Logical indicating whether the univariate pdf should be used.
score	String indicating which score to use in optimization: f1 (default) or mcc.
steps	Integer number of steps to take during epsilon optimization, default 1e3.

Details

amelie implements anomaly detection with normal probability functions and maximum likelihood estimates.

Features are assumed to be continuous, and the target is assumed to take on values of 0 (negative case, no anomaly) or 1 (positive case, anomaly).

The threshold epsilon is optimized using the either the Matthews correlation coefficient or F1 score.

Variance and covariance are computed using var and cov, where denominator n-1 is used.

Algorithm details are described in the Introduction vignette.

The package follows the anomaly detection approach in Andrew Ng's course on machine learning.

Value

An object of class ad:

call	The original call to ad.
univariate	Logical indicating which pdf was computed.
score	The score that was used for optimization.
epsilon	The threshold value.
train_mean	Means of features in the training set.
train_var	Variances of features in the training set. If univariate=FALSE

, holds the covariance matrix for the features.

val_score	The score obtained on the validation data set. 0 to 1 for F1 score, -1 to 1 for Matthews correlation coefficient
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References

[Machine learning course](#)
[Confusion matrix](#)
[Matthews correlation coefficient](#)

Examples

```
x1 <- c(1, .2, 3, 1, 1, .7, -2, -1)
x2 <- c(0, .5, 0, .4, 0, 1, -.3, -.1)
x <- do.call(cbind, list(x1, x2))
y <- c(0, 0, 0, 0, 0, 0, 1, 1)
dframe <- data.frame(x, y)
df_fit <- ad(y ~ x1 + x2, dframe)
mat_fit <- ad(x = x, y = y)
```

amelie

amelie: A package for anomaly detection.

Description

Anomaly detection with maximum likelihood estimates and normal probability functions.

Amelie functions

The package contains a function for running the anomaly detection algorithm.

More information

[ad](#) documents the main ad function.

For more details and examples, see the vignette.

pdfunc *Compute the probability density function of a matrix of features.*

Description

Compute the probability density function of a matrix of features.

Usage

```
pdfunc(x, univariate = TRUE)
```

Arguments

`x` A matrix of numeric features.
`univariate` Logical indicating whether the univariate pdf should be computed.

Details

pdfunc computes univariate or multivariate probabilities for a set of observations. All columns of a row are used in computing the pdf. Variance and covariance are computed using `var` and `cov`, where the denominator $n-1$ is used.

Value

A vector with values of the density function.

Examples

```
dmat <- matrix(c(3,1,3,1,2,3,-1,0),nrow=2)
pdfunc(dmat,TRUE)

#'@importFrom stats cov
```

predict.ad *Predict method for ad Objects*

Description

Predict method for ad Objects

Usage

```
## S3 method for class 'ad'
predict(object, newdata, type = "class",
        na.action = na.pass, ...)
```

Arguments

<code>object</code>	An object of class <code>ad</code> , created by the function <code>ad</code> .
<code>newdata</code>	A data frame or matrix containing new data.
<code>type</code>	One of <code>'class'</code> (for class prediction) or <code>'prob'</code> (for probabilities).
<code>na.action</code>	A function specifying the action to be taken if NAs are found; default is to predict NA (<code>na.pass</code>).
<code>...</code>	Currently not used.

Details

Specifying `'class'` for `type` returns the class of each observation as anomalous or non-anomalous. Specifying `'prob'` returns the probability of each observation.

Value

A vector of predicted values.

Examples

```
x1 <- c(1,.2,3,1,1,.7,-2,-1)
x2 <- c(0,.5,0,.4,0,1,-.3,-.1)
x <- do.call(cbind,list(x1,x2))
y <- c(0,0,0,0,0,0,1,1)
dframe <- data.frame(x,y)
df_fit <- ad(y ~ x1 + x2, dframe)
predict(df_fit, newdata = dframe)
```

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