

Package ‘eve’

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Title The Eigenvalues Entropy as a Classifier Evaluation Measure

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Depends R (>= 4.0),

Description The confusion matrix (CM) is used to get a classifier's evaluation measure in order to select a method among many. A stochastic matrix and its transformation are computed from the CM. The eigenvalues of the transformed symmetric matrix are used to get an entropy which appears to be a good evaluation measure. Many other measures, commonly used, are provided for comparison purpose.

License GPL (>= 2)

NeedsCompilation no

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eve-package	<i>The Eigenvalues Entropy as a Classifier Evaluation Measure</i>
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Description

eve allows to compute the eigenvalues entropy and many other commonly used classifier evaluation measures. For comparison purpose, all measures computed are adjusted to vary in [0,1].

Details

Package: eve
Type: Package
Version: 1.1
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License: GPL (>=2.0)

This package has the following functions:

- eve(): The function allowing to compute the eigenvalues entropy measure.
- eve.mmatt(): This function allows to compute a modified confusion matrix which is useful for imbalanced problem.
- eve.bounds(): This function allows to compute lower and upper bound values for the eigenvalues used to get the EVE evaluation measure.
- eve.eigens(): This function gives access to the eigenvalues used to get the EVE evaluation measure.
- eve.bival(): This function allows to compute the sensitivity, the specificity, the precision, the Fowlkes and Mallows index, the F1-score and the area under the ROC curve, for a binary problem.
- eve.acc(): The function computes the accuracy.
- eve.nmi(): This function computes the normalized mutual information value.
- eve.mcc(): This function computes the Matthews correlation coefficient, a shifted value is returned.
- eve.kappa(): This function computes the Cohen’s Kappa measure value.
- eve.cen(): This function computes the confusion entropy of the misclassification.
A shifted value is returned.
- eve.mcen(): This function compute the modified confusion entropy of the misclassification.
A shifted value is returned.
- m2two.a(): This function converts a multiclass confusion matrix into a binary confusion class.
- m2two.k(): This function allows to get a confusion matrix of the comparison of one class (k) versus the others.

Author(s)

Doulaye Dembele Maintainer: Doulaye Dembele <doulaye@igbmc.fr>

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,43),ncol=3)

eve(mmat)
eve.acc(mmat)
eve.kappa(mmat)
eve.mcc(mmat)
eve.nmi(mmat)
eve.cen(mmat)
eve.mcen(mmat)

eve.mmatt(mmat)

res <- m2two.a(mmat)
eve.bival(res)
eve.kappa(res)
eve(res)

res <- m2two.k(mmat,2)
eve.bival(res)
eve.mcc(res)
eve.acc(res)

mmat <- matrix(c(9,1,80,210),ncol=2)
eve.bival(mmat)
eve.bival(eve.mmatt(mmat))
eve(mmat)
eve(eve.mmatt(mmat))
```

eve

Eigenvalue entropy calculation

Description

This function computes the eigenvalues entropy for a binary or a multiclass confusion matrix.

Usage

```
eve(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns the eigenvalue entropy, a numerical value for evaluating a classifier.

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve(mmat)
```

`eve.acc`

Accuracy calculation

Description

This function computes the accuracy for a binary or amulticlass confusion matrix.

Usage

```
eve.acc(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a numerical value, the accuracy associated with the confusion matrix.

Author(s)

Doulaye Dembele

References

E.B. Fowlkes and C.L. Mallows. A method for Comparing Two Hierarchical Clusterings. J Am Stat Assoc, 1983, v78, n383, pp553-569

A.K. Jain and R. Dubes. Algorithms for Clustering Data. Prentice Hall, Englewood, New Jersey, 1988.

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.acc(mmat)
```

eve.amat	<i>Return the bounds matrix A</i>
----------	-----------------------------------

Description

This function returns the matrix A allowing to get the eigenvalues bounds.

Usage

```
eve.amat(mmat)
```

Arguments

mmat a square numerical-valued confusion matrix.

Value

This function returns the matrix which allows to compute the lower and the upper eigenvalues.

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.amat(mmat)
```

`eve.bival`*Some binary measures calculation*

Description

This function computes the sensitivity, the specificity, the precision, the Fowlkes & Mallows index, the F1-score, the area under the ROC curve and the GINI index for a binary problem confusion matrix.

Usage

```
eve.bival(mmat)
```

Arguments

`mmat` a 2 x 2 numerical-valued confusion matrix.

Value

This function returns the sensitivity, the specificity, the precision, the Fowlkes & Mallows index, the F1-score and the area under the ROC curve measure values.

Author(s)

Doulaye Dembele

References

H. Cramer. Mathematical Methods of Statistics.
Princeton Univ Press, 1946.

E.B. Fowlkes and C.L. Mallows. A method for Comparing Two Hierarchical Clusterings.
J Am Stat Assoc, 1983, v78, n383, pp553-569

A.K. Jain and R. Dubes. Algorithms for Clustering Data.
Prentice Hall, Englewood, New Jersey, 1988.

J. Furnkranz and P.A. Flach. ROC'n' Rule Learning - Towards a Better Understanding of Covering Algorithms.
Mach Learn, 2005, v58, pp39-77.

D.J. Hand. Measuring Classifier Performance: a Coherent Alternative to the Area Under the ROC Curve.
Mach Learn, 2009, v77, pp367-374.

D.M.W. Powers. Evaluation from Precision, Recall and F-measure to ROC, Informmedness, Markedness and Correlation.
arXiv, 2020, 2010.16061.

Examples

```
mmat <- matrix(c(434,10,7,232), ncol=2)
eve.bival(mmat)
```

eve.bmat	<i>Return the bounds matrix B</i>
----------	-----------------------------------

Description

This function returns the matrix B allowing to compute the EVE measure eigenvalues.

Usage

```
eve.bmat(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns the matrix B which eigenvalues are used in the EVE measure.

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.bmat(mmat)
```

eve.bounds

Eigenvalues bounds calculation

Description

This function computes a lower and an upper bound values for the eigenvalues associated with a confusion matrix transformation.

Usage

```
eve.bounds(mmat)
```

Arguments

mmat a square numerical-valued confusion matrix.

Value

This function returns a vector which entries are a lower and an upper bound for the eigenvalues associated with a confusion matrix transformation. The range of these bounds is small (<2) for a good classifier.

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. [arXiv:2511.01904](https://arxiv.org/abs/2511.01904)

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.bounds(mmat)
```

eve.cen*Confusion entropy calculation*

Description

This function computes the confusion entropy for a binary or a multiclass confusion matrix. A shifted value is returned

Usage

```
eve.cen(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a numerical value, a shifted confusion entropy (1-CEN).

Author(s)

Doulaye Dembele

References

J.M. Wei, X.J. Yuan, Q.H. Hu and S.Q. Wang. A Novel Measure for Evaluating Classifiers. Expert Syst Appl, 2010, v15 pp4969-4992.

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.cen(mmat)
```

eve.eigens

Eigenvalues used in the EVE measure

Description

This function give access to the eigenvalues associated with a confusion matrix transformation.

Usage

```
eve.eigens(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns the eigenvalues used to obtain the EVE evaluation measure. For a binary problem, they can be used to obtain the AUC or the Gini index (coefficient).

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.eigens(mmat)
```

eve.kappa

Cohen's Kappa calculation

Description

This function computes the Cohen's kappa measure for a binary or a multiclass confusion matrix.

Usage

```
eve.kappa(mmat)
```

Arguments

mmat a square numerical-valued confusion matrix.

Value

This function returns a numerical value, the Cohen kappa evaluation measure.

Author(s)

Doulaye Dembele

References

J. Cohen. A Coefficient of Agreement for Nominal Scales.
Educ Psychol Meas, 1960, v20 n1 pp37-46

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.kappa(mmat)
```

eve.mcc*Matthews' correlation coefficient calculation*

Description

This function computes the Matthews' correlation coefficient for a binary or a multiclass confusion matrix.

Usage

```
eve.mcc(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a numerical value, a shifted Matthews correlation coefficient which varies in [0,1].

Author(s)

Doulaye Dembele

References

B.W. Matthews. Comparison of the Predicted and observed Secondary Structures of T4 Phage Lysozyme. Biochem Biophys Acta, 1975, v405 pp442-451.

J. Gorodkin. Comparing Two K-Category Assignments by a K-Category Correlation Coefficient. Comput Biol Chem, 2004, v28 pp367-374.

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.mcc(mmat)
```

eve.mcen

*Modified confusion entropy calculation***Description**

This function computes the modified confusion entropy for a binary or a multiclass confusion matrix. A shifted value is returned

Usage

```
eve.mcen(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a numerical value, a shifted modified confusion entropy (1-MCEN).

Author(s)

Doulaye Dembele

References

R. Delgado and J.D. Nunez-Gonzalez. Enhancing Confusion Entropy CEN for Binary and Multiclass Classification. PLoS One, 2019, v14, n1, e0210264.

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.mcen(mmat)
```

eve.mmatt

*Modified confusion matrix calculation***Description**

This function computes a modified confusion matrix for a binary or a multiclass problem.

Usage

```
eve.mmatt(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a modified confusion matrix which can be used to improve a measure sensitive to imbalanced ratio.

Author(s)

Doulaye Dembele

References

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.mmatt(mmat)
```

`eve.nmi`*Normalized mutual information calculation*

Description

This function computes the normalized mutual information for a binary or a multiclass confusion matrix.

Usage

```
eve.nmi(mmat)
```

Arguments

`mmat` a square numerical-valued confusion matrix.

Value

This function returns a numerical value, the normalized mutual information.

Author(s)

Doulaye Dembele

References

T.M. Cover and J.A. Thomas. Elements of Information Theory. Wiley, 2006, 2nd edition, Hoboken, New Jersey.

I. Kononenko and I Bratko. Information-Based Evaluation Criterion of Classifiers Performance. Mach Learn, 1991, v6, pp67-80.

N.X. Vinh, J. Epps and J. Bailey. Information Theoretic Measures for Clusterings Comparison: Variants, Properties, Normalization and Correction for Chance. J Mach Learn Res, 2010, v11 pp2837-2854.

Examples

```
m2two.a <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
eve.nmi(m2two.a)
```

m2two.a

Conversion of a multicass confusion matrix to a single binary confusion matrix

Description

This function converts a multiclass confusion into a single binary confusion matrix.

Usage

```
m2two.a(mmat)
```

Arguments

mmat a square numerical-valued confusion matrix.

Value

This function returns a 2 x 2 confusion matrix which can be used for evaluating a classifier.

Author(s)

Doulaye Dembele

References

A.K. Jain and R. Dubes. Algorithms for Clustering Data. Prentice Hall, Englewood, New Jersey, 1988.

N.X. Vinh, J. Epps and J. Bailey. Information Theoretic Measures for Clusterings Comparison: Variants, Properties, Normalization and Correction for Chance. J Mach Learn Res, 2010, v11 pp2837-2854.

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
m2two.a(matrix(c(50,0,0,0,35,15,0,7,34), ncol=3))
```

m2two.k

Comparison of the class k versus the rest

Description

This function allows to compare the class k versus the others for a multiclass problem.

Usage

```
m2two.k(mmat,k=1)
```

Arguments

mmat a square numerical-valued confusion matrix.
k the index of the class to compare to the others.

Value

This function returns a 2 x 2 confusion matrix which can be used for evaluating a classifier. The class k is compared to the others.

Author(s)

Doulaye Dembele

References

H. Cramer. Mathematical Methods of Statistics.
Princeton Univ Press, 1946.

E.B. Fowlkes and C.L. Mallows. A method for Comparing Two Hierarchical Clusterings.
J Am Stat Assoc, 1983, v78, n383, pp553-569

A.K. Jain and R. Dubes. Algorithms for Clustering Data.
Prentice Hall, Englewood, New Jersey, 1988.

Dembele D. (2025), The Eigenvalues Entropy as a Classifier Evaluation Measure. arXiv:2511.01904

Examples

```
mmat <- matrix(c(50,0,0,0,35,15,0,7,34), ncol=3)
m2two.k(mmat,2)
```

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