Package ‘MDMeasure’

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Title Mutual Dependence Measures via Energy Statistics

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Description Implementation of mutual dependence measures and
mutual independence tests in Jin, Z. and Matteson, D. S. (2017)
<https://arxiv.org/abs/1709.02532>.

Depends R (>= 3.4.0)

Suggests testthat (>= 2.0.0),
energy (>= 1.7-0)

License GPL (>= 2)

LazyData true

RoxygenNote 6.0.1

Collate 'MDMeasure-package.R'
'mdm.R'
'mdm_test.R'

R topics documented:

`MDMeasure-package` *Mutual Dependence Measures via Energy Statistics*

Description

MDMeasure: A package for mutual dependence measures via energy statistics

Details

The MDMeasure package provides measures of mutual dependence and tests of mutual independence.

Measuring mutual dependence

The mutual dependence measures include:

- asymmetric measure $\mathcal{R}_n$ based on distance covariance $\mathcal{V}_n$

- symmectric measure $\mathcal{S}_n$ based on distance covariance $\mathcal{V}_n$

- complete measure $\mathcal{Q}_n$ based on complete V-statistics

- simplified complete measure $\mathcal{Q}_n^\star$ based on incomplete V-statistics

- asymmetric measure $\mathcal{J}_n$ based on complete measure $\mathcal{Q}_n$

- simplified asymmetric measure $\mathcal{J}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$

- symmectric measure $\mathcal{I}_n$ based on complete measure $\mathcal{Q}_n$

- simplified symmectric measure $\mathcal{I}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$

Testing mutual independence

The mutual independence tests based on the mutual dependence measures are implemented as permutation tests.

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`mdm` *Mutual Dependence Measures*

Description

`mdm` measures mutual dependence of all components in `X`, where each component contains one variable (univariate) or more variables (multivariate).

Usage

```
mdm(X, dim_comp = NULL, dist_comp = FALSE, type = "comp_simp")
```

Arguments

`X`	A matrix or data frame, where rows represent samples, and columns represent variables.
`dim_comp`	The numbers of variables contained by all components in `X`. If omitted, each component is assumed to contain exactly one variable.
`dist_comp`	Logical. If `TRUE`, the distances between all components from all samples in `X` will be returned.
`type`	The type of mutual dependence measures, including - `asym_dcov`: asymmetric measure $\mathcal{R}_n$ based on distance covariance $\mathcal{V}_n$; - `sym_dcov`: symmectric measure $\mathcal{S}_n$ based on distance covariance $\mathcal{V}_n$; - `comp`: complete measure $\mathcal{Q}_n$ based on complete V-statistics; - `comp_simp`: simplified complete measure $\mathcal{Q}_n^\star$ based on incomplete V-statistics; - `asym_comp`: asymmetric measure $\mathcal{J}_n$ based on complete measure $\mathcal{Q}_n$;

- asym_comp_simp: simplified asymmetric measure $\mathcal{J}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$;
- sym_comp: symmectric measure $\mathcal{I}_n$ based on complete measure $\mathcal{Q}_n$;
- sym_comp_simp: simplified symmectric measure $\mathcal{I}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$.

Value

mdm returns a list including the following components:

stat	The value of mutual dependence measure.
dist	The distances between all components from all samples.

References

Jin, Z. and Matteson, D. S. (2017). Generalizing Distance Covariance to Measure and Test Multivariate Mutual Dependence. arXiv preprint arXiv:1709.02532. https://arxiv.org/abs/1709.02532.

Examples

```
# X is a 10 x 3 matrix with 10 samples and 3 variables
X <- matrix(rnorm(10 * 3), 10, 3)

# assume \eqn{X = (X_1, X_2)} where \eqn{X_1 \in \mathbb{R}^1}, \eqn{X_2 \in \mathbb{R}^2}
mdm(X, dim_comp = c(1, 2), type = asym_dcov)

# assume \eqn{X = (X_1, X_2)} where \eqn{X_1 \in \mathbb{R}^2}, \eqn{X_2 \in \mathbb{R}^1}
mdm(X, dim_comp = c(2, 1), type = sym_dcov)

# assume \eqn{X = (X_1, X_2, X_3)} where
# \eqn{X_1 \in \mathbb{R}^1}, \eqn{X_2 \in \mathbb{R}^1}, \eqn{X_3 \in \mathbb{R}^1}
mdm(X, dim_comp = c(1, 1, 1), type = comp_simp)
```

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mdm_test *Mutual Independence Tests*

Description

mdm_test tests mutual independence of all components in X, where each component contains one variable (univariate) or more variables (multivariate). All tests are implemented as permutation tests.

Usage

```
mdm_test(X, dim_comp = NULL, num_perm = NULL, type = c("comp_simp"))
```

Arguments

X	A matrix or data frame, where rows represent samples, and columns represent variables.
dim_comp	The numbers of variables contained by all components in X. If omitted, each component is assumed to contain exactly one variable.
num_perm	The number of permutation samples drawn to approximate the asymptotic distributions of mutual dependence measures. If omitted, an adaptive permutation size is used.
type	The type of mutual dependence measures, including - asym_dcov: asymmetric measure $\mathcal{R}_n$ based on distance covariance $\mathcal{V}_n$; - sym_dcov: symmectric measure $\mathcal{S}_n$ based on distance covariance $\mathcal{V}_n$; - comp: complete measure $\mathcal{Q}_n$ based on complete V-statistics; - comp_simp: simplified complete measure $\mathcal{Q}_n^\star$ based on incomplete V-statistics; - asym_comp: asymmetric measure $\mathcal{J}_n$ based on complete measure $\mathcal{Q}_n$; - asym_comp_simp: simplified asymmetric measure $\mathcal{J}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$; - sym_comp: symmectric measure $\mathcal{I}_n$ based on complete measure $\mathcal{Q}_n$; - sym_comp_simp: simplified symmectric measure $\mathcal{I}_n^\star$ based on simplified complete measure $\mathcal{Q}_n^\star$.

Value

mdm_test returns a list including the following components:

stat	The value of mutual dependence measure.
pval	The p-value of mutual independence test.

References

Jin, Z. and Matteson, D. S. (2017). Generalizing Distance Covariance to Measure and Test Multivariate Mutual Dependence. arXiv preprint arXiv:1709.02532. https://arxiv.org/abs/1709.02532.

Examples

```
X <- matrix(rnorm(30), 10, 3)
mdm_test(X, type = comp_simp)
```

Index