

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>>.
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Suggests testthat (>= 2.0.0),
energy (>= 1.7-0)
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Collate 'MDMeasure-package.R'
'mdm.R'
'mdm_test.R'

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MDMeasure-package	<i>Mutual Dependence Measures via Energy Statistics</i>
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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
- symmetric 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^* based on incomplete V-statistics
- asymmetric measure \mathcal{J}_n based on complete measure \mathcal{Q}_n
- simplified asymmetric measure \mathcal{J}_n^* based on simplified complete measure \mathcal{Q}_n^*
- symmetric measure \mathcal{I}_n based on complete measure \mathcal{Q}_n
- simplified symmetric measure \mathcal{I}_n^* based on simplified complete measure \mathcal{Q}_n^*

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 <ul style="list-style-type: none"> • asym_dcov: asymmetric measure \mathcal{R}_n based on distance covariance \mathcal{V}_n; • sym_dcov: symmetric 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^* 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^* based on simplified complete measure \mathcal{Q}_n^* ;
- `sym_comp`: symmetric measure \mathcal{I}_n based on complete measure \mathcal{Q}_n ;
- `sym_comp_simp`: simplified symmetric measure \mathcal{I}_n^* based on simplified complete measure \mathcal{Q}_n^* .

Value

`mdm` returns a list including the following components:

<code>stat</code>	The value of the mutual dependence measure.
<code>dist</code>	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 X = (X1, X2) where X1 is 1-dim, X2 is 2-dim
mdm(X, dim_comp = c(1, 2), type = "asym_dcov")

# assume X = (X1, X2) where X1 is 2-dim, X2 is 1-dim
mdm(X, dim_comp = c(2, 1), type = "sym_dcov")

# assume X = (X1, X2, X3) where X1 is 1-dim, X2 is 1-dim, X3 is 1-dim
mdm(X, dim_comp = c(1, 1, 1), type = "comp_simp")
```

<code>mdm_test</code>	<i>Mutual Independence Tests</i>
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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 = "comp_simp")
```

Arguments

<code>X</code>	A matrix or data frame, where rows represent samples, and columns represent variables.
<code>dim_comp</code>	The numbers of variables contained by all components in <code>X</code> . If omitted, each component is assumed to contain exactly one variable.
<code>num_perm</code>	The number of permutation samples drawn to approximate the asymptotic distributions of mutual dependence measures. If omitted, an adaptive number is used.
<code>type</code>	The type of mutual dependence measures, including <ul style="list-style-type: none"> • <code>asym_dcov</code>: asymmetric measure \mathcal{R}_n based on distance covariance \mathcal{V}_n; • <code>sym_dcov</code>: symmetric measure \mathcal{S}_n based on distance covariance \mathcal{V}_n; • <code>comp</code>: complete measure \mathcal{Q}_n based on complete V-statistics; • <code>comp_simp</code>: simplified complete measure \mathcal{Q}_n^* based on incomplete V-statistics; • <code>asym_comp</code>: asymmetric measure \mathcal{J}_n based on complete measure \mathcal{Q}_n; • <code>asym_comp_simp</code>: simplified asymmetric measure \mathcal{J}_n^* based on simplified complete measure \mathcal{Q}_n^*; • <code>sym_comp</code>: symmetric measure \mathcal{I}_n based on complete measure \mathcal{Q}_n; • <code>sym_comp_simp</code>: simplified symmetric measure \mathcal{I}_n^* based on simplified complete measure \mathcal{Q}_n^*.

Value

`mdm_test` returns a list including the following components:

<code>stat</code>	The value of the mutual dependence measure.
<code>pval</code>	The p-value of the 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

```
## Not run:
# X is a 10 x 3 matrix with 10 samples and 3 variables
X <- matrix(rnorm(10 * 3), 10, 3)

# assume X = (X1, X2) where X1 is 1-dim, X2 is 2-dim
mdm_test(X, dim_comp = c(1, 2), type = "asym_dcov")

# assume X = (X1, X2) where X1 is 2-dim, X2 is 1-dim
mdm_test(X, dim_comp = c(2, 1), type = "sym_dcov")

# assume X = (X1, X2, X3) where X1 is 1-dim, X2 is 1-dim, X3 is 1-dim
mdm_test(X, dim_comp = c(1, 1, 1), type = "comp_simp")

## End(Not run)
```

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