

Package ‘cdcsis’

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Type Package

Title Conditional Distance Correlation Based Feature Screening and Conditional Independence Inference

Description Conditional distance correlation <doi:10.1080/01621459.2014.993081> is a novel conditional dependence measurement of two multivariate random variables given a confounding variable. This package provides conditional distance correlation, performs the conditional distance correlation sure independence screening procedure for ultrahigh dimensional data <doi:10.5705/ss.202014.0117>, and conducts conditional distance covariance test for conditional independence assumption of two multivariate variable.

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Suggests testthat

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cdcsis-package	<i>Conditional Distance Correlation Based Feature Screening and Conditional Independence Inference</i>
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Description

Conditional distance correlation <doi:10.1080/01621459.2014.993081> is a novel conditional dependence measurement of two multivariate random variables given a confounding variable. This package provides conditional distance correlation, performs the conditional distance correlation sure independence screening procedure for ultrahigh dimensional data <doi:10.5705/ss.202014.0117>, and conducts conditional distance covariance test for conditional independence assumption of two multivariate variable.

Author(s)

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References

- Wang, X., Pan, W., Hu, W., Tian, Y. and Zhang, H., 2015. Conditional distance correlation. *Journal of the American Statistical Association*, 110(512), pp.1726-1734.
- Wen, C., Pan, W., Huang, M. and Wang, X., 2018. Sure independence screening adjusted for confounding covariates with ultrahigh-dimensional data. *Statistica Sinica*, 28, pp.293-317.

cdcov	<i>Conditional Distance Covariance/Correlation Statistics</i>
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Description

Computes conditional distance covariance and conditional distance correlation statistics, which are multivariate measures of conditional dependence.

Usage

```
cdcov(x, y, z, width = ifelse(is.vector(z), ks::hpi(z),
  diag(ks::Hpi.diag(z))), index = 1, distance = FALSE)
```

```
cdcor(x, y, z, width = ifelse(is.vector(z), ks::hpi(z),
  diag(ks::Hpi.diag(z))), index = 1, distance = FALSE)
```

Arguments

x	a numeric vector, matrix, or dist object
y	a numeric vector, matrix, or dist object
z	z is a numeric vector or matrix. It is the variable being conditioned.
width	a user-specified positive value (univariate conditional variable) or vector (multivariate conditional variable) for gaussian kernel bandwidth. Its default value is relies on <code>ks::hpi</code> or <code>ks::Hpi.diag</code> function.
index	exponent on Euclidean distance, in $(0, 2]$
distance	if <code>distance = TRUE</code> , x and y will be considered as distance matrices. Default: <code>distance = FALSE</code>

Details

`cdcov` and `cdcor` compute conditional distance covariance and conditional distance correlation statistics. The sample sizes (number of rows or length of the vector) of the two variables must agree, and samples must not contain missing values. If we set `distance = TRUE`, arguments `x`, `y` can be a `dist` object recording distance between samples; otherwise, these arguments are treated as multivariate data.

Value

<code>cdcov</code>	sample version of conditional distance covariance.
<code>cdcor</code>	sample version of conditional distance correlation.

Author(s)

Canhong Wen, Wenliang Pan, and Xueqin Wang

References

Wang, X., Pan, W., Hu, W., Tian, Y. and Zhang, H., 2015. Conditional distance correlation. *Journal of the American Statistical Association*, 110(512), pp.1726-1734.

See Also

[cdcor](#)

Examples

```

library(cdcov)

##### Conditional Distance Correlation #####
set.seed(1)
x <- rnorm(25)
y <- rnorm(25)
z <- rnorm(25)
cdcov(x, y, z)

##### Conditional Distance Correlation #####
num <- 25
set.seed(1)
x <- rnorm(num)
y <- rnorm(num)
z <- rnorm(num)
cdcor(x, y, z)

```

cdcov.test

Conditional Distance Covariance Independence Test

Description

Performs the nonparametric conditional distance covariance test for conditional independence assumption

Usage

```

cdcov.test(x, y, z, num.bootstrap = 99, width = ifelse(is.vector(z),
  stats::bw.nrd0(z), diag(ks::Hpi.diag(z))), index = 1,
  distance = FALSE, seed = 1, num.threads = 1)

```

Arguments

x	a numeric vector, matrix, or dist object
y	a numeric vector, matrix, or dist object
z	z is a numeric vector or matrix. It is the variable being conditioned.
num.bootstrap	the number of local bootstrap procedure replications. Default: num.bootstrap = 99
width	a user-specified positive value (univariate conditional variable) or vector (multivariate conditional variable) for gaussian kernel bandwidth. Its default value is relies on stats::bw.nrd0 or ks::Hpi.diag function.
index	exponent on Euclidean distance, in (0, 2]
distance	if distance = TRUE, x and y will be considered as distance matrices. Default: distance = FALSE
seed	the random seed
num.threads	number of threads. Default num.threads = 1.

Value

cdcov.test returns a list with class "htest" containing the following components:

statistic	conditional distance covariance statistic.
p.value	the p -value for the test.
replicates	the number of local bootstrap procedure replications.
size	sample sizes.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	description of data.

See Also

[cdcov](#)

Examples

```
library(cdcov)
set.seed(1)
num <- 50
##### Conditional Independent #####
## Case 1:
cov_mat <- matrix(c(1, 0.36, 0.6, 0.36, 1, 0.6, 0.6, 0.6, 1), nrow = 3)
dat <- mvtnorm::rmvnorm(n = num, sigma = cov_mat)
x <- dat[, 1]
y <- dat[, 2]
z <- dat[, 3]
cdcov.test(x, y, z)
## Case 2:
z <- rnorm(num)
x <- 0.5 * (z^3 / 7 + z / 2) + tanh(rnorm(num))
x <- x + x^3 / 3
y <- (z^3 + z) / 3 + rnorm(num)
y <- y + tanh(y / 3)
cdcov.test(x, y, z, num.bootstrap = 99)

##### Conditional Dependent #####
## Case 3:
cov_mat <- matrix(c(1, 0.7, 0.6, 0.7, 1, 0.6, 0.6, 0.6, 1), nrow = 3)
dat <- mvtnorm::rmvnorm(n = num, sigma = cov_mat)
x <- dat[, 1]
y <- dat[, 2]
z <- dat[, 3]
cdcov.test(x, y, z, width = 0.5)
## Case 4:
z <- matrix(rt(num * 4, df = 2), nrow = num)
x <- z
y <- cbind(sin(z[, 1]) + cos(z[, 2]) + (z[, 3])^2 + (z[, 4])^2,
           (z[, 1])^2 + (z[, 2])^2 + z[, 3] + z[, 4])
z <- z[, 1:2]
```

```

cdcov.test(x, y, z, seed = 2)

##### Distance Matrix Input #####
x <- dist(x)
y <- dist(y)
cdcov.test(x, y, z, seed = 2, distance = TRUE)

```

cdc sis *Conditional Distance Correlation Sure Independence Screening (CDC-SIS)*

Description

Performs conditional distance correlation sure independence screening (CDC-SIS).

Usage

```

cdc sis(x, y, z = NULL, width = ifelse(is.vector(z), ks:hpi(z),
  diag(ks:hpi.diag(z))), threshold = nrow(y), distance = FALSE,
  index = 1, num.threads = 1)

```

Arguments

x	a numeric matrix, or a list which contains multiple numeric matrix
y	a numeric vector, matrix, or dist object
z	z is a numeric vector or matrix. It is the variable being conditioned.
width	a user-specified positive value (univariate conditional variable) or vector (multivariate conditional variable) for gaussian kernel bandwidth. Its default value is relies on ks:hpi or ks:hpi.diag function.
threshold	the threshold of the number of predictors recruited by CDC-SIS. Should be less than or equal than the number of column of x. Default value threshold is sample size.
distance	if distance = TRUE, only y will be considered as distance matrices. Default: distance = FALSE
index	exponent on Euclidean distance, in (0, 2]
num.threads	number of threads. Default num.threads = 1.

Value

ix	the vector of indices selected by CDC-SIS
cdcor	the conditional distance correlation for each univariate/multivariate variable in x

Author(s)

Canhong Wen, Wenliang Pan, Mian Huang, and Xueqin Wang

References

Wen, C., Pan, W., Huang, M. and Wang, X., 2018. Sure independence screening adjusted for confounding covariates with ultrahigh-dimensional data. *Statistica Sinica*, 28, pp.293-317.

See Also

[cdcor](#)

Examples

```
library(cdcsis)

##### univariate explanation variables #####
set.seed(1)
num <- 100
p <- 200
x <- matrix(rnorm(num * p), nrow = num)
z <- rnorm(num)
y <- 3 * x[, 1] + 1.5 * x[, 2] + 4 * z * x[, 5] + rnorm(num)
res <- cdcsis(x, y, z)
head(res[["ix"]], n = 10)

##### multivariate explanation variables #####
x <- as.list(as.data.frame(x))
x <- lapply(x, as.matrix)
x[[1]] <- cbind(x[[1]], x[[2]])
x[[2]] <- NULL
res <- cdcsis(x, y, z)
head(res[["ix"]], n = 10)
```

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