Package 'weightedGCM'

November 29, 2021

Type Package

Title Weighted Generalised Covariance Measure Conditional Independence
Test

Version 0.1.0

Description A conditional independence test that can be applied both to
univariate and multivariate random variables. The test is based on a
weighted form of the sample covariance of the residuals after a
nonlinear regression on the conditioning variables. Details are
described in Scheidegger, Hoerrmann and Buehlmann (2021) ``The Weighted
Generalised Covariance Measure'' <arXiv:2111.04361>. The test is a
generalisation of the Generalised Covariance Measure (GCM) implemented
in the R package 'GeneralisedCovarianceMeasure' by Jonas Peters and
Rajen D. Shah based on Shah and Peters (2020) ``The Hardness of
Conditional Independence Testing and the Generalised Covariance
Measure'' <arXiv:1804.07203>.

License GPL-2

Imports GeneralisedCovarianceMeasure, methods, mgcv, stats, xgboost

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

Encoding UTF-8

RoxygenNote 7.1.1

NeedsCompilation no

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Repository CRAN

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R topics documented:

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wgcm.est	*Weighted Generalised Covariance Measure (WGCM) With Estimated Weight Function Conditional Independence Test*

Description

The Weighted Generalised Covariance Measure (WGCM) with Estimated Weight Function is a test for conditional independence. It is a generalisation of the Generalised Covariance Measure implemented in the R package GeneralisedCovarianceMeasure.

Usage

```
wgcm.est(X, Y, Z, beta = 0.3, regr.meth, regr.pars = list(), nsim = 499)
```

Arguments

X	A (n x d_X) numeric matrix with n observations of d_X variables.
Y	A (n x d_Y) numeric matrix with n observations of d_Y variables.
Z	A (n x d_Z) numeric matrix with n observations of d_Z variables.
beta	A real number between 0 and 1 indicating the fraction of the sample used to estimate the weight function.
regr.meth	One of "gam" and "xgboost" indicating the regression method used to estimate the conditional expectations E[X|Z] and E[Y|Z] and the weight function sign(E[(X-E[X|Z])(Y-E[Y|Z])|Z]).
regr.pars	Optional additional regression parameters according to GeneralisedCovarianceMeasure::comp.resids()
nsim	Number of samples used to calculate the p-value using simulation. Only used if max(d_X, d_Y) > 1.

Value

A p-value for the null hypothesis of conditional independence of X and Y given Z.

References

Please cite the following papers. Cyrill Scheidegger, Julia Hoerrmann, Peter Buehlmann: "The Weighted Generalised Covariance Measure" https://arxiv.org/abs/2111.04361

Rajen D. Shah, Jonas Peters: "The Hardness of Conditional Independence Testing and the Generalised Covariance Measure" https://arxiv.org/abs/1804.07203

Examples

```
set.seed(1)
n <- 200
Z <- rnorm(n)
X <- Z + 0.3*rnorm(n)
Y1 <- Z + 0.3*rnorm(n)
Y2 <- Z + 0.3*rnorm(n) + 0.3*X
Y3 <- Z + 0.3*rnorm(n) + 0.15*X^2
wgcm.est(X, Y1, Z, beta = 0.3, regr.meth = "gam")
wgcm.est(X, Y2, Z, beta = 0.3, regr.meth = "gam")
wgcm.est(X, Y3, Z, beta = 0.3, regr.meth = "gam")
```

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wgcm.fix	*Weighted Generalised Covariance Measure (WGCM) With Fixed Weight Functions Conditional Independence Test*

Description

The Weighted Generalised Covariance Measure (WGCM) with Fixed Weight Functions is a test for conditional independence. It is a generalisation of the Generalised Covariance Measure implemented in the R package GeneralisedCovarianceMeasure.

Usage

```
wgcm.fix(
  X,
  Y,
  Z,
  regr.meth,
  regr.pars = list(),
  weight.num,
  weight.meth = "sign",
  nsim = 499
)
```

Arguments

X	A (n x d_X) numeric matrix with n observations of d_X variables.
Y	A (n x d_Y) numeric matrix with n observations of d_Y variables.

Z	A (n x d_Z) numeric matrix with n observations of d_Z variables.
regr.meth	One of "gam" and "xgboost" indicating the regression method used to estimate the conditional expectations $E[X|Z]$ and $E[Y|Z]$.
regr.pars	Optional additional regression parameters according to GeneralisedCovariance-Measure::comp.resids().
weight.num	Number k_0 of weight functions per dimension of Z to be used additionally to the constant weight function $w(z) = 1$. The total number of weight functions will be $1 + k\_0 * d\_Z$. In case of $max(d\_X, d\_Y) > 1$, the same $1 + k\_0 * d\_Z$ weight functions are used for every combination of the components of X and Y.
weight.meth	String indicating the method to choose the weight functions. Currently, only "sign" is implemented.
nsim	Number of samples used to calculate the p-value using simulation.

Value

A p-value for the null hypothesis of conditional independence of X and Y given Z.

References

Please cite the following papers. Cyrill Scheidegger, Julia Hoerrmann, Peter Buehlmann: "The Weighted Generalised Covariance Measure" https://arxiv.org/abs/2111.04361

Rajen D. Shah, Jonas Peters: "The Hardness of Conditional Independence Testing and the Generalised Covariance Measure" https://arxiv.org/abs/1804.07203

Examples

```
set.seed(1)
n <- 200
Z <- rnorm(n)
X <- Z + 0.3*rnorm(n)
Y1 <- Z + 0.3*rnorm(n)
Y2 <- Z + 0.3*rnorm(n) + 0.3*X
Y3 <- Z + 0.3*rnorm(n) + 0.15*X^2
wgcm.fix(X, Y1, Z, regr.meth = "gam", weight.num = 7, weight.meth = "sign")
wgcm.fix(X, Y2, Z, regr.meth = "gam", weight.num = 7, weight.meth = "sign")
wgcm.fix(X, Y3, Z, regr.meth = "gam", weight.num = 7, weight.meth = "sign")
```

Index