

Package ‘weightedGCM’

July 22, 2025

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" <doi:10.48550/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" <doi:10.48550/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

Author Cyrill Scheidegger [aut, cre],
Julia Hoerrmann [ths],
Peter Buehlmann [ths],
Jonas Peters [ctb, cph] (The code in 'trainFunctions.R' is copied (with small modifications) from the R package
'GeneralisedCovarianceMeasure' by Jonas Peters and Rajen D. Shah),
Rajen D. Shah [ctb, cph] (The code in 'trainFunctions.R' is copied (with small modifications) from the R package
'GeneralisedCovarianceMeasure' by Jonas Peters and Rajen D. Shah)

Maintainer Cyrill Scheidegger <cyrill.scheidegger@stat.math.ethz.ch>

Repository CRAN

Date/Publication 2021-11-29 09:50:02 UTC

Contents

wgcm.est	2
wgcm.fix	3
Index	5

wgcm.est	<i>Weighted Generalised Covariance Measure (WGCM) With Estimated Weight Function Conditional Independence Test</i>
----------	--

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 $\text{sign}(E[(X-E[X Z])(Y-E[Y Z]) Z])$.
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")
```

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.

<code>Z</code>	A ($n \times d_Z$) numeric matrix with n observations of d_Z variables.
<code>regr.meth</code>	One of "gam" and "xgboost" indicating the regression method used to estimate the conditional expectations $E[X Z]$ and $E[Y Z]$.
<code>regr.pars</code>	Optional additional regression parameters according to <code>GeneralisedCovarianceMeasure::comp.resids()</code> .
<code>weight.num</code>	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 .
<code>weight.meth</code>	String indicating the method to choose the weight functions. Currently, only "sign" is implemented.
<code>nsim</code>	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

wgcm.est, [2](#)

wgcm.fix, [3](#)