

Package ‘MTest’

July 21, 2025

Type Package

Title A Procedure for Multicollinearity Testing using Bootstrap

Version 1.0.2

Date 2023-10-06

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Description

Functions for detecting multicollinearity. This test gives statistical support to two of the most famous methods for detecting multicollinearity in applied work: Klein’s rule and Variance Inflation Factor (VIF). See the URL for the papers associated with this package, as for instance, Morales-Oñate and Morales-Oñate (2015) <[doi:10.33333/rp.vol51n2.05](https://doi.org/10.33333/rp.vol51n2.05)>.

Depends R (>= 4.1.0)

License GPL (>= 3)

Encoding UTF-8

Imports car, ggplot2, plotly

Repository CRAN

URL <https://github.com/vmoprojs/MTest>

BugReports <https://github.com/vmoprojs/MTest/issues>

LazyData true

NeedsCompilation no

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Date/Publication 2023-10-06 13:10:02 UTC

Contents

MTest	2
pairwiseKStest	3
plot.MTest	5
simDataMTest	5

MTest	<i>MTest</i>
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Description

MTest is a nonparametric test based on bootstrap for detecting multicollinearity. This test gives statistical support to two of the most famous methods for detecting multicollinearity in applied work: Klein's rule and Variance Inflation Factor (VIF for essential multicollinearity).

Usage

```
MTest(object, nboot = 100,
      nsam = NULL, trace = FALSE, seed = NULL,
      valor_vif = 0.9)
```

Arguments

object	an object representing a model of an appropriate class (mainly "lm"). This is used as the model in MTest.
nboot	Numeric; number of bootstrap iterations to obtain the probability distribution of R squared (global and auxiliar).
nsam	Numeric; sample size for bootstrap samples.
trace	Logical; prints iteration process.
seed	Numeric; seed value for the bootstrap in nboot parameter.
valor_vif	Numeric; value to be compared in kleins rule.

Details

MTest generates a bootstrap distribution for the coefficient of determination which lets the researcher assess multicollinearity by setting a statistical significance α , or more precisely, an achieved significance level (ASL) for a given threshold.

Consider the regression model

$$Y_i = \beta_0 X_{0i} + \beta_1 X_{1i} + \cdots + \beta_p X_{pi} + u_i$$

where $i = 1, \dots, n$, $X_{j,i}$ are the predictors with $j = 1, \dots, p$, $X_0 = 1$ for all i and u_i is the gaussian error term.

In order to describe Klein's rule and VIF methods, we need to define *auxiliary regressions* associated to model. An example of an auxiliary regressions is:

$$X_{2i} = \gamma_1 X_{1i} + \gamma_3 X_{3i} + \cdots + \gamma_p X_{pi} + u_i.$$

In general, there are p auxiliary regressions and the dependent variable is omitted in each auxiliary regression. Let R_g^2 be the coefficient of determination of the model and R_j^2 the j th coefficient of determination of the j th auxiliary regression.

Value

Returns an object of class MTest. An object of class MTest is a list containing at most the following components:

pval_vif	p values for vif test;
pval_klein	p values for klein test;
Bvals	A $nboot \times (p + 1)$ matrix where rows are the number of bootstrap samples and the columns are R_{gboot}^2 and R_{jboot}^2 which are estimates of estimates of R_g^2 and R_j^2 , see Section Details
vif.tot	Observed VIF values;
R.tot	Observed R_g^2 and R_j^2 values;
nsam	sample size used in bootstrap procedure.

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References

Morales-Oñate, V., and Morales-Oñate, B. (2023). *MTest: a Bootstrap Test for Multicollinearity*. Revista Politécnica, 51(2), 53–62. doi:10.33333/rp.vol51n2.05

Examples

```
library(MTest)
data(simDataMTest)
m1 <- lm(y~.,data = simDataMTest)

boot.sol <- MTest(m1,trace=FALSE,seed = 1,nboot = 50)
boot.sol$pval_vif
boot.sol$pval_klein
head(boot.sol$Bvals)
print(boot.sol)
```

pairwiseKStest

pairwiseKStest

Description

Returns the p -value of the columns of X (pairwisely).

Usage

```
pairwiseKStest(X,alternative="greater")
```

Arguments

X	Numeric; a matrix (Bvals output from MTest function) whose columns are to be compared.
alternative	String; letter of the value, but the argument name must be given in full. See 'ks.test' for the meanings of the possible values.

Details

Using a pairwise Kolmogorov-Smirnov (KS) test of a given matrix X. In particular, if X is the Bvals output from MTest function, pairwiseKStest establishes a guide for an educated removal of variables that are causing multicollinearity.

Note that the matrix $B_{n_{boot} \times (p+1)}$ (which is Bvals output from MTest function) allow us to inspect results in detail and make further tests such as boxplots, pairwise Kolmogorov-Smirnov (KS) of the predictors and so on.

Value

Returns an object of class pairwiseKStest. An object of class pairwiseKStest is a list containing at most the following components:

KSpwMatrix	p-values matrix of pairwise KS testing;
alternative	Character; indicates the alternative hypothesis.
Suggestion	Character; indicates row sums (or col sums) of KSpwMatrix suggesting the removal order in case that is the strategy for dealing with multicollinearity.

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References

Morales-Oñate, V., and Morales-Oñate, B. (2023). *MTest: a Bootstrap Test for Multicollinearity*. Revista Politécnica, 51(2), 53–62. doi:10.33333/rp.vol51n2.05

Examples

```
library(MTest)
data(simDataMTest)
pairwiseKStest(X=simDataMTest)
```

plot.MTest	<i>Plot density or empirical cumulative distribution from MTest</i>
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Description

Plot density or empirical cumulative distribution from Bvals in [MTest](#) output.

Usage

```
## S3 method for class 'MTest'  
plot(x, type=1, plotly = FALSE, ...)
```

Arguments

x	an object of the class "MTest"
type	Numeric; 1 if density, 2 if ecdf plot is returned
plotly	Logical; if FALSE, a ggplotly plot is returned
...	other arguments to be passed to the function ggplot

Details

This function plots density or empirical cumulative distribution function from MTest bootstrap replications.

Value

Produces a plot. No values are returned.

See Also

[MTest](#) for procedure and examples.

simDataMTest	<i>Simulated data for MTest</i>
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Description

This data set helps testing functions in MTest package, the generating process is documented in the reference.

Usage

```
simDataMTest
```

Format

A dataframe containing 10000 observations and four columns.

References

Morales-Oñate, V., and Morales-Oñate, B. (2023). *MTest: a Bootstrap Test for Multicollinearity*. Revista Politécnica, 51(2), 53–62. doi:[10.33333/rp.vol51n2.05](https://doi.org/10.33333/rp.vol51n2.05)

Index

- * **KS**
 - pairwiseKStest, [3](#)
- * **MTest**
 - plot.MTest, [5](#)
- * **Multicollinearity**
 - MTest, [2](#)
- * **datasets**
 - simDataMTest, [5](#)

ggplot, [5](#)

MTest, [2](#), [5](#)

pairwiseKStest, [3](#)

plot.MTest, [5](#)

simDataMTest, [5](#)