Package ‘mvnTest’

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Title Goodness of Fit Tests for Multivariate Normality

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Description Routines for assessing multivariate normality. Implements three Wald's type chi-
squared tests; non-parametric Anderson-Darling and Cramer-von Mises tests; Doornik-
Hansen test, Royston test and Henze-Zirkler test.

Depends R (>= 2.15.0), mvtnorm

Imports methods, stats, graphics, MASS

License GPL (>= 2)

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**Description**

`mvntest` provides functions for assessing multivariate normality. It includes eight test statistics such as three Wald's type chi-squared tests (McCulloch, Nikulin-Rao-Robson and Dzhaparidze-Nikulin tests), non-parametric Anderson-Darling and Cramer-von Mises tests; Doornik-Hansen test, Royston test and Henze-Zirkler test.

**Details**

```
Package: mvntest
Type: Package
License: GPL (>= 2)
```

**Note**

The printing method and plotting are in part adapted from R package `mvn` (version 4.0, Korkmaz, S. et al., 2015)

**Author(s)**

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**ad-class**

**Class** "ad"

**Description**

An S4 class for the Anderson-Darling test for multivariate normality.

**Slots**

- `Ad`: stores the values of the test statistics
- `p.value`: stores the p-value of the test
- `data.name`: stores the name of the data

**Author(s)**

Natalya Pya, Vassilly Voinov, Rashid Makarov
**Description**

This function implements the Anderson-Darling test for assessing multivariate normality. It calculates the value of the test and its approximate p-value.

**Usage**

```r
AD.test(data, qqplot = FALSE)
```

**Arguments**

- `data`: A numeric matrix or data frame.
- `qqplot`: If TRUE produces a chi-squared QQ plot.

**Value**

- `AD`: the value of the test statistic.
- `p.value`: the p-value of the test.

**Note**

The printing method and plotting are in part adapted from R package `MVN` (version 4.0, Korkmaz, S. et al., 2015).

The computations are relatively expensive as Monte Carlo procedure is used to calculate empirical p-values.

**Author(s)**

Rashid Makarov, Vassilly Voinov, Natalya Pya

**References**


**See Also**

- `S2.test`, `CM.test`, `DH.test`, `R.test`, `HZ.test`
Examples

```r
## Not run:
## generating n bivariate normal random variables...
dat <- rmvnorm(n=100, mean=rep(0,2), sigma=matrix(c(4,2,2,4),2,2))
res <- AD.test(dat)
res

## generating n bivariate t distributed with 10df random variables...
dat <- rmvt(n=200, sigma=matrix(c(4,2,2,4),2,2), df=10, delta=rep(0,2))
res1 <- AD.test(dat)
res1

data(iris)
setosa <- iris[1:50, 1:4] # Iris data only for setosa
res2 <- AD.test(setosa, qqplot = TRUE)
res2

## End(Not run)
```

---

**cm-class**

*Class “cm”*

**Description**

An S4 class for the Cramer-von Mises test for multivariate normality.

**Slots**

- `cm`: stores the values of the test statistics
- `p.value`: stores the p-value of the test
- `data.name`: stores the name of the data

**Author(s)**

Natalya Pya, Vassilly Voinov, Rashid Makarov

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**CM.test**

*Cramer-von Mises test for Multivariate Normality*

**Description**

This function implements the Cramer-von Mises test for assessing multivariate normality.

**Usage**

```r
CM.test(data, qqplot = FALSE)
```
Arguments

data A numeric matrix or data frame
qqplot if TRUE creates a chi-square Q-Q plot

Details
Calculates the value of the Cramer-von Mises test and the approximate p-value.

Value

CM the value of the test statistic
p.value the p-value of the test
data.name a character string giving the name of the data

Note
The printing method and plotting are in part adapted from R package MVN (version 4.0, Korkmaz, S. et al., 2015).
The computations are relatively expensive as Monte Carlo procedure is used to calculate empirical p-values.

Author(s)
Rashid Makarov, Vassilly Voinov, Natalya Pya

References

See Also
S2.test, AD.test, DH.test, R.test, HZ.test

Examples

## Not run:
## generating n bivariate normal random variables...
dat <- rmvnorm(n=100,mean=rep(0,2),sigma=matrix(c(4,2,2,4),2,2))
res <- CM.test(dat)
res

## generating n bivariate t distributed with 10df random variables...
dat <- rmvt(n=200,sigma=matrix(c(4,2,2,4),2,2),df=10,delta=rep(0,2))
res1 <- CM.test(dat)
res1
data(iris)
setosa <- iris[1:50, 1:4] # Iris data only for setosa
res2 <- CM.test(setosa, qqplot = TRUE)

## End(Not run)

dh-class

Class "dh"

Description

An S4 class for the Doornik-Hansen test for multivariate normality.

Slots


dh: stores the values of the test statistics
p.value: stores the p-value of the test
data.name: stores the name of the data

Author(s)

Natalya Pya, Vassily Voinov, Rashid Makarov

DH.test

Doornik-Hansen test for Multivariate Normality

Description

This function implements the Doornik-Hansen test for assessing multivariate normality.

Usage

DH.test(data, qqplot = FALSE)

Arguments

data A numeric matrix or data frame
qqplot if TRUE creates a chi-square Q-Q plot

Details

Calculates the value of the Doornik-Hansen test and the approximate p-value.
Value

<table>
<thead>
<tr>
<th>DH</th>
<th>the value of the test statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>p.value</td>
<td>the p-value of the test</td>
</tr>
<tr>
<td>data.name</td>
<td>a character string giving the name of the data</td>
</tr>
</tbody>
</table>

Note

The printing method and plotting are in part adapted from R package MVN (version 4.0, Korkmaz, S. et al., 2015).

Author(s)

Rashid Makarov, Vassilly Voinov, Natalya Pya

References


See Also

S2.test, AD.test, CM.test, R.test, HZ.test

Examples

```r
## generating n bivariate normal random variables...
dat <- rmvnorm(n=200, mean=rep(0,2), sigma=matrix(c(4,2,2,4),2,2))
res <- DH.test(dat)

## generating n bivariate t distributed with df random variables...
dat <- rmvt(n=200, sigma=matrix(c(4,2,2,4),2,2)*.8, df=10, delta=rep(0,2))
res1 <- DH.test(dat)

data(iris)
setosa <- iris[1:50, 1:4] # Iris data only for setosa
res2 <- DH.test(setosa, qqplot = TRUE)
res2
```

hz-class  

Class "hz"

Description

An S4 class for the Henze-Zirkler test for multivariate normality.
Slots

HZ: stores the values of the test statistics
p.value: stores the p-value of the test
data.name: stores the name of the data

Author(s)

Natalya Pya, Vassilly Voinov, Rashid Makarov

Description

This function implements the Henze-Zirkler test for assessing multivariate normality.

Usage

HZ.test(data, qqplot = FALSE)

Arguments

data A numeric matrix or data frame
qqplot if TRUE creates a chi-square Q-Q plot

Details

Calculates the value of the Henze-Zirkler test and the approximate p-value.

Value

HZ the value of the test statistic
p.value the p-value of the test
data.name a character string giving the name of the data

Note

The printing method and plotting are in part adapted from R package MVN (Korkmaz, S. et al., 2015, version 4.0).

Author(s)

Rashid Makarov, Vassilly Voinov, Natalya Pya
References


See Also

S2.test, DH.test, AD.test, CM.test, R.test

Examples

```r
## generating n bivariate normal random variables...
dat <- rmvnorm(n=200,mean=rep(0,2),sigma=matrix(c(4,2,2,4),2,2))
res <- HZ.test(dat)
res
## generating n bivariate t distributed with 10df random variables...
dat <- rmvt(n=200,sigma=matrix(c(4,2,2,4),2,2)*.8,df=10,delta=rep(0,2))
res1 <- HZ.test(dat)
res1
data(iris)
setosa = iris[1:50, 1:4] # Iris data only for setosa
res2 <- HZ.test(setosa, qqplot = TRUE)
res2
```

r-class

Class "r"

Description

An S4 class for the Royston test for multivariate normality.

Slots

- `r`: stores the values of the test statistics
- `p.value`: stores the p-value of the test
- `data.name`: stores the name of the data

Author(s)

Natalya Pya, Vassily Voinov, Rashid Makarov
R.test  
Royston test for Multivariate Normality

Description
This function implements the Royston test for assessing multivariate normality.

Usage
R.test(data, qqplot = FALSE)

Arguments
data A numeric matrix or data frame
qqplot if TRUE creates a chi-square Q-Q plot

Details
Calculates the value of the Royston test and the approximate p-value.

Value
R the value of the test statistic
p.value the p-value of the test
data.name a character string giving the name of the data

Note
The printing method and plotting are in part adapted from R package mvn (Korkmaz, S. et al., 2015, version 4.0).

Author(s)
Rashid Makarov, Vassilly Voinov, Natalya Pya

References

See Also
S2.test, DH.test, AD.test, CM.test, HZ.test
Examples

```r
## generating n bivariate normal random variables...
dat <- rmvnorm(n=200,mean=rep(0,2),sigma=matrix(c(4,2,2,4),2,2))
res <- R.test(dat)

## generating n bivariate t distributed with 10df random variables...
res1 <- R.test(res)
```

```
data(iris)
setosa = iris[1:50, 1:4] # Iris data only for setosa
res2 <- R.test(setosa, qqplot = TRUE)
```

S2-class

```
Class "S2"
```

Description

An S4 class for Chi-squared type tests for multivariate normality.

Slots

- `s2`: stores the values of the McCulloch test statistics
- `y2`: stores the values of the Nikulin-Rao-Robson test statistics
- `u2`: stores the values of the Dzhaparidze-Nikulin test statistics
- `p.value.s2`: stores the p-value for S2 test
- `p.value.y2`: stores the p-value for Y2 test
- `p.value.u2`: stores the p-value for U2 test
- `data.name`: stores the data set name

Author(s)

Natalya Pya, Vassilly Voinov, Rashid Makarov
**Chi-squared type tests for Multivariate Normality**

**Description**

This function implements three chi-squared type goodness-of-fit tests for multivariate normality, namely, the McCulloch S2 test, Nikulin-Rao-Robson Y2 and Dzhaparidze-Nikulin U2 tests.

**Usage**

S2.test(data, M=5, qqplot = FALSE)

**Arguments**

- `data`: A numeric matrix or data frame
- `M`: A number of equiprobable intervals
- `qqplot`: if TRUE it creates a chi-square Q-Q plot

**Details**

Calculates the values of the three chi-squared type test statistics, the McCulloch S2, Nikulin-Rao-Robson Y2 and Dzhaparidze-Nikulin U2 tests, and the corresponding p-values. The construction of all three tests is based on the Wald’s type chi-squared goodness-of-fit tests. The vector of unknown parameters is estimated by the maximum likelihood method. The Karhunen-Loeve transformation is applied to a multi-dimensional sample data in order to diagonalize a sample covariance matrix. The null asymptotic distributions of the S2, Y2 and U2 tests are chi-squared distributions with 1, $M-1$ and $M-2$ degrees of freedom correspondingly.

**Value**

- `s2`: the value of the McCulloch test S2
- `p.value.s2`: the p-value of S2 test
- `y2`: the value of the Nikulin-Rao-Robson test Y2
- `p.value.y2`: the p-value of Y2 test
- `u2`: the value of the Dzhaparidze-Nikulin test U2
- `p.value.u2`: the p-value of U2 test
- `data.name`: a character string giving the name of the data

**Note**

The displayed result about multivariate normality is based on the McCulloch S2 test.

**Author(s)**

Vassilly Voinov, Natalya Pya, Rashid Makarov, Yevgeniy Voinov
References


See Also

AD.test, DH.test, R.test, CM.test, HZ.test

Examples

```r
## generating n bivariate normal random variables...
dat <- rmvnorm(n=200, mean=rep(0,2), sigma=matrix(c(4,2,2,4),2,2))
res <- S2.test(dat, qqplot = FALSE)
res
## generating n bivariate t distributed with 10df random variables...
dat <- rmvt(n=200, sigma=matrix(c(4,2,2,4),2,2)*.8, df=10, delta=rep(0,2))
res1 <- S2.test(dat, qqplot = TRUE)
res1

data(iris)
setosa = iris[1:50, 1:4] # Iris data only for setosa
res2 <- S2.test(setosa, qqplot = TRUE)
res2
```
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