Package ‘MVNtestchar’

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Type Package

Title Multivariate Normal Distribution Characterization Test

Version 1.0.2

Date 2020-04-18

Encoding UTF-8

Description Provides a test of multivariate normality of a sample which does not require estimation of the nuisance parameters, the mean and covariance matrix. Rather, a sequence of transformations removes these nuisance parameters and results in a set of sample matrices that are positive definite. These matrices are uniformly distributed on the space of positive definite matrices in the unit hyperrectangle if and only if the original data is multivariate normal. The package performs a goodness of fit test of this hypothesis. Four sample datasets are included: a bivariate and a trivariate normal set and a bivariate and trivariate Bernoulli set. In addition to the test, functions in the package give rotatable visualizations of the support region of positive definite matrices for bivariate samples.

Depends R (>= 2.10)

Imports graphics, grDevices, Hmisc, stats, utils, ggplot2

License GPL (>= 2)

NeedsCompilation no

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RoxygenNote 7.0.2

Suggests testthat, knitr, rmarkdown

VignetteBuilder knitr

Repository CRAN

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Description

Provides a test of multivariate normality of a sample which does not require estimation of the nuisance parameters, the mean and covariance matrix. Rather, a sequence of transformations removes these nuisance parameters and results in a set of sample matrices that are positive definite. These matrices are uniformly distributed on the space of positive definite matrices in the unit hyperrectangle if and only if the original data is multivariate normal. The package performs a goodness of fit test of this hypothesis. Four sample datasets are included: a bivariate and a trivariate normal set and a bivariate and trivariate Bernoulli set. In addition to the test, functions in the package give rotatable visualizations of the support region of positive definite matrices for bivariate samples.

Details

The DESCRIPTION file:

- Package: MVNtestchar
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- Title: Multivariate Normal Distribution Characterization Test
- Version: 1.0.2
- Date: 2020-04-18
- Encoding: UTF-8
- Authors@R: person("William", "Fairweather", email = "wrf343@flowervalleyconsulting.com", role = c("aut", "cre"))
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- Depends: R (>= 2.10)
- Imports: graphics, grDevices, Hmisc, stats, utils, ggplot2
- License: GPL (>=2)
- NeedsCompilation: no
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- Author: William Fairweather [aut, cre]
- Maintainer: William Fairweather <wrf343@flowervalleyconsulting.com>
MVNtestchar-package

RoxygenNote: 7.0.2
Suggests: testthat, knitr, rmarkdown
VignetteBuilder: knitr

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                        Distribution
unknown.Np2               A Sample From an Unknown Bivariate Distribution
unknown.Np4               A Sample From an Unknown Four-variate
                        Distribution

Provides a test of multivariate normality of a sample which does not require estimation of the
nuisance parameters, the mean vector and covariance matrix. Rather, a sequence of transformations
removes these nuisance parameters, resulting in a set of sample matrices that are positive definite in
the unit hyperrectangle. If, and only if the original data is multivariate normal, these matrices are
uniformly distributed on the space of positive definite matrices. The package performs a goodness
of fit test of this hypothesis. In addition to the test, functions in the package give visualizations of
the support region of positive definite matrices for p equals 2.

Author(s)

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"cre"))

References

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Csorgo M and Seshadri V (1971). Characterizing the Gaussian and exponential laws by mappings
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Washington, Seattle WA
**maxv12**  
*Rotatable Plot of Surface of Possible Maximum Values of Off-diagonal Variable*

**Description**
Rotatable plot of surface of possible maximum values of off-diagonal variable v12 in positive definite 2 x 2 matrix as a function of the diagonal variables v1 and v2.

**Usage**
```
maxv12(theta = 30, phi = 30, inc = 25, lseq = 200, static=FALSE, ticktype="detailed", diagnose = FALSE, verbose = TRUE)
```

**Arguments**
- `theta`: left-right plot rotation parameter in degrees
- `phi`: up-down plot rotation parameter in degrees
- `inc`: increment in degrees of plot rotations
- `lseq`: number of cut points in v1 and in v2
- `static`: Logical. TRUE causes suppression of rotation
- `ticktype`: simple or detailed ticks on variables
- `diagnose`: Logical. TRUE causes printing of diagnostic content
- `verbose`: Logical. TRUE causes printing of program ID before and after running

**Value**
List including latest values of elements
- `theta`: left-right plot rotation parameter in degrees
- `phi`: up-down plot rotation parameter in degrees
- `lseq`: number of cut points in v1 and in v2
- `inc`: increment in degrees of plot rotations
- `ticktype`: simple or detailed ticks on variables

**Author(s)**
William R. Fairweather

**See Also**
support.p2()

**Examples**
```
maxv12(theta = 30, phi = 30, inc = 25, lseq = 200, static=TRUE, ticktype = "detailed", diagnose = FALSE, verbose = TRUE)
```
slice.v1

Rotatable Plot of Slice Through Support Region in Positive Definite 2 x 2 Matrix

Description

Rotatable plot of slice through support region in positive definite 2 x 2 matrix at fixed value of diagonal variable v1

Usage

slice.v1(level3 = 0.6, theta = 0, phi = 60, inc = 25, lseq = 100, static=FALSE, ticktype="detailed", diagnose = FALSE, verbose = TRUE)

Arguments

  level3  Level of V1 where slice is taken
  theta   left-right plot rotation parameter in degrees
  phi     up-down plot rotation parameter in degrees
  lseq    number of cut points in v1 and in v2
  inc     increment in degrees of plot rotations
  static  Logical. TRUE causes suppression of rotation
  ticktype simple or detailed ticks on variables
  diagnose Logical. T causes printing of diagnostic content
  verbose Logical. T causes printing of program ID before and after running

Value

List including latest values of elements

  level3  Level of V1 where slice is taken
  theta   left-right plot rotation parameter in degrees
  phi     up-down plot rotation parameter in degrees
  lseq    number of cut points in v1 and in v2
  inc     increment in degrees of plot rotations
  ticktype simple or detailed ticks on variables

Author(s)

William R. Fairweather

See Also

  support.p2()
Examples
	slice.v1(level3 = 0.6, theta = 60, phi = 60, inc = 25, lseq = 100, 
static=TRUE, ticktype = "detailed")

Description

Rotatable plot of slice through support region in positive definite 2 x 2 matrix at fixed value of the off-diagonal variable v12

Usage

slice.v12(level3 = 0.3, theta = 30, phi = 10, inc = 25, lseq = 100, static = FALSE, 
ticktype="detailed", diagnose = FALSE, verbose = TRUE)

Arguments

level3 Level of V1 where slice is taken
theta left-right plot rotation parameter in degrees
phi up-down plot rotation parameter in degrees
inc increment in degrees of plot rotations
lseq number of cut points in v1 and in v2
static Logical. TRUE causes suppression of rotation
ticktype simple or detailed ticks on variables
diagnose Logical. T causes printing of diagnostic content
verbose Logical. T causes printing of program ID before and after running

Value

List including latest values of elements

level3 Level of V1 where slice is taken
theta left-right plot rotation parameter in degrees
phi up-down plot rotation parameter in degrees
lseq number of cut points in v1 and in v2
inc increment in degrees of plot rotations
ticktype simple or detailed ticks on variables

Author(s)

William R. Fairweather
support.p2

See Also

support.p2()

Examples

slice.v12(level3 = 0.3, theta = 30, phi = 10, inc = 25, lseq = 100,
static=TRUE, ticktype = "detailed")

Description

Rotatable plot of support region for positive definite matrix with p=2

Usage

support.p2(theta = 110, phi = 10, lseq = 150, inc = 25, static = FALSE,
ticktype="detailed",diagnose = FALSE, verbose = TRUE)

Arguments

- theta: left-right plot rotation parameter in degrees
- phi: up-down plot rotation parameter in degrees
- lseq: number of cut points in v1 and in v2
- inc: increment in degrees of plot rotations
- ticktype: simple or detailed ticks on variables
- static: Logical. TRUE suppresses rotation
- diagnose: Logical. TRUE causes printing of diagnostic content
- verbose: Logical. TRUE causes printing of program ID before and after running

Details

Support region for p-variate positive definite matrix distributions is difficult to envision except for p=2. The diagonals of the matrix are V1 and V2 and the off-diagonal variable is V12. In our application 0<=V1,V2<=1, and -1<=V12<=1, so the bounded space is a hyperrectangle. Each point in this region represents a symmetric pxp matrix, but not all of these are positive definite. This function shades the region of positive definite matrices.

Value

List including latest values of elements

- theta: left-right plot rotation parameter in degrees
- phi: up-down plot rotation parameter in degrees
- lseq: number of cut points in v1 and in v2
- inc: increment in degrees of plot rotations
- ticktype: simple or detailed ticks on variables
Author(s)
William R. Fairweather

Examples

```r
support.p2(theta = 110, phi = 10, lseq = 150, inc = 25,
        static = TRUE, ticktype = "detailed")
```

testunknown Test the Sample Vectors for Normality Distribution

Description
Transform to positive definite matrices without nuisance parameters. Tabulate distribution of matrices. Calculate goodness of fit to uniform.

Usage

```r
testunknown(x, pvector, k, diagnose.s = FALSE, diagnose = FALSE,
             verbose = TRUE)
```

Arguments

- `x` Name of matrix or array.
- `pvector` Dimensionality of random vectors
- `k` Number of cuts per unit for diagonal elements of matrix. Program uses 2k cuts per unit for off-diagonal elements
- `diagnose.s` Logical T causes printing of diagnostic terms in internal called function(s)
- `diagnose` Logical. T causes printing of diagnostic content
- `verbose` Logical. T causes printing of function ID before and after running

Value

- `Distribution` List. Count of positive definite matrices within individual subcubes of positive definite space, 1 for each layer of list
- `Goodness of fit` List. Chi square test of goodness of fit to uniform distribution, 1 for each layer of list
- `Call` Call to testunknown function

Author(s)
William R. Fairweather
unknown.Bp2

References


Examples

data(unknown.Np2)
testunknown(x=unknown.Np2, pvector=2, k=20, diagnose.s = FALSE, diagnose = FALSE, verbose = TRUE)

unknown.Bp2  A Sample From an Unknown Bivariate Distribution

Description

A 3600 x 2 x 1 array generated from 7200 modified Bernoulli(0,1) variables. Variables were modified by adding a normal random variate with very small variance to each Bernoulli variable in order to avoid creating degenerate matrices during operation of the test function.

Usage

data("unknown.Bp2")

Format

3600 x 2 x 1 array

Source

Generated by the author

Examples

data("unknown.Bp2")
unknown.Bp4  

**Description**  
A 6000 x 4 x 1 array generated from 24,000 Bernoulli(0,1) variables. Variables were modified by adding a normal random variate with very small variance to each Bernoulli variable in order to avoid creating degenerate matrices during operation of the test function.

**Usage**  
```r  
data("unknown.Bp4")  
```

**Format**  
6000 x 4 x 1 array

**Source**  
Generated by the author

**Examples**  
```r  
data("unknown.Bp4")  
```

unknown.Np2  

**Description**  
A 2500 x 2 matrix generated from 5000 normal(0,1) variables

**Usage**  
```r  
data("unknown.Np2")  
```

**Format**  
2500 x 2 matrix

**Source**  
Generated by the author

**Examples**  
```r  
data("unknown.Np2")  
```
unknown.Np4

---

**A Sample From an Unknown Four-variate Distribution**

---

**Description**

A 6000 x 4 x 1 array generated from 24000 normal(0,1) variables

**Usage**

```r
data("unknown.Np4")
```

**Format**

6000 x 4 x 1 array

**Source**

Generated by the author

**Examples**

```r
data("unknown.Np4")
```
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