Package ‘MVNtestchar’

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Type Package

Title Test for Multivariate Normal Distribution Based on a Characterization

Version 1.1.3

Date 2020-07-14

Description Provides a test of multivariate normality of an unknown sample that 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 hyper-rectangle if and only if the original data is multivariate normal (Fairweather, 1973, Doctoral dissertation, University of Washington). 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 bivariate samples.

Depends R (>= 2.10)

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

License GPL (>= 2)

NeedsCompilation no

Suggests markdown

VignetteBuilder knitr, markdown

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Description

Provides a test of multivariate normality of an unknown sample that 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 hyper-rectangle if and only if the original data is multivariate normal (Fairweather, 1973, Doctoral dissertation, University of Washington). 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 bivariate samples.

Details

The DESCRIPTION file:

- Package: MVNtestchar
- Type: Package
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- Version: 1.1.3
- Date: 2020-07-14
- Authors@R: person("William", "Fairweather", email = "wrf343@flowervalleyconsulting.com", role = c("aut", "cre"))
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NeedsCompilation: no
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Maintainer: William Fairweather <wrf343@flowervalleyconsulting.com>

Index of help topics:
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. If, and only if the original data is multivariate normal, these matrices are uniformly distributed on the space of positive definite matrices in the unit hyper-rectangle. 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)

person("Fairweather", "William", email = "wrf343@flowervalleyconsulting.com", role = c("aut", "cre"))

References

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

Usage
maxv12(theta = 30, phi = 30, inc = 25, lseq = 200, 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
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
Output is a plot that is rotatable via keyboard input. Upon exit, the latest values of the rotation parameters is listed to facilitate return to the latest plot

Author(s)
William R. Fairweather

See Also
support.p2()

Examples
## Not run: maxv12(theta = 30, phi = 30, inc = 25, lseq = 200, ticktype = "detailed", diagnose = FALSE, verbose = TRUE)

## End(Not run)
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, 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
- **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

Output is a plot that is rotatable via keyboard input. Upon exit, the latest values of the rotation parameters is listed to facilitate return to the latest plot

Author(s)

William R. Fairweather

See Also

support.p2()

Examples

```r
## Not run: slice.v1(level3 = 0.6, theta = 0, phi = 60, inc = 25, lseq = 100,
##      ticktype = "detailed")

## End(Not run)```
slice.v12  

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 off-diagonal variable v12

Usage

slice.v12(level3 = 0.3, theta = 30, phi = 10, inc = 25, lseq = 100, 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
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

Output is a plot that is rotatable via keyboard input. Upon exit, the latest values of the rotation parameters is listed to facilitate return to the latest plot

Author(s)

William R. Fairweather

See Also

support.p2()

Examples

## Not run: slice.v12(level3 = 0.3, theta = 30, phi = 10, inc = 25, lseq = 100, ticktype = "detailed")

## End(Not run)
support.p2

Show Support Region of Positive Definite Matrices with Rank 2

Description

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

Usage

support.p2(theta = 110, phi = 10, lseq = 150, inc = 25, 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
diagnose Logical. T causes printing of diagnostic content
verbose Logical. T 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 hyper-rectangle. 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

Output is a plot that is rotatable via keyboard input. Upon exit, the latest values of the rotation parameters is listed to facilitate return to the latest plot

Author(s)

William R. Fairweather

Examples

### Not run: support.p2(theta = 110, phi = 10, lseq = 150, inc = 25,
          ticktype = "detailed")

### End(Not run)
testunknown

Process the Samples Whose Distribution is to be Tested

Description

Create positive definite matrices without nuisance parameters. Tabulate distribution. Calculate

goodness of fit

Usage

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

a list including elements

Distribution
   List. Count of pd matrices within individual subcubes of pd 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

References

Csorgo, M and Seshadri, V (1970). On the problem of replacing composite hypotheses by equiva-
   izing the Gaussian and exponential laws by mappings onto the unit interval, Z. Wahrscheinlichkeit-
   on a characterization. Dissertation submitted in partial fulfillment of the requirements for the Doctor
   of Philosophy, University of Washington, Seattle WA.
unknown.Bp2

**Examples**
```r
data(unknown.Bp2)
testunknown(x=unknown.Bp2, 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.

**Usage**
```r
data("unknown.Bp2")
```

**Format**
3600 x 2 x 1 array

**Source**
Generated by the author

**Examples**
```r
data("unknown.Bp2")
```

---

unknown.Bp4

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

**Description**
A 6000 x 4 matrix generated from 24,000 Bernoulli(0,1) variables

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

**Format**
6000 x 4 x 1 array

**Source**
Generated by the author
**unknown.Np2**  
*A Sample From an Unknown Bivariate Distribution*

**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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