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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`MVNtestchar-package` *Test for Multivariate Normal Distribution Based on a Characterization*

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
Title:	Test for Multivariate Normal Distribution Based on a Characterization
Version:	1.1.3
Date:	2020-07-14
Authors@R:	person("William", "Fairweather", email = "wrf343@flowervalleyconsulting.com", role = c("aut", "cre"))
Description:	Provides a test of multivariate normality of an unknown sample that does not require estimation of the n
Depends:	R (>= 2.10)
Imports:	graphics, grDevices, Hmisc, stats, utils, knitr, ggplot2
License:	GPL (>=2)
NeedsCompilation:	no
Suggests:	markdown
VignetteBuilder:	knitr, markdown
Packaged:	2020-03-11 18:35:57 UTC; No
Author:	William Fairweather [aut, cre]
Maintainer:	William Fairweather <wrf343@flowervalleyconsulting.com>

Index of help topics:

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slice.v12	Rotatable Plot of Slice Through Support Region in Positive Definite 2 x 2 Matrix
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unknown.Bp4	A Sample From an Unknown Four-variate 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. 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

Anderson, TW. (1958), An Introduction to Multivariate Statistical Analysis, John Wiley, New York.

Cramer, H (1962). Random Variables and Probability Distributions, Cambridge University Press, London.

Csorgo M and Seshadri V (1970). On the problem of replacing composite hypotheses by equivalent simple ones, Rev. Int. Statist. Instit., 38, 351-368

Csorgo M and Seshadri V (1971). Characterizing the Gaussian and exponential laws by mappings onto the unit interval, Z. Wahrscheinlickhkeitstheorie verw. Geb., 18, 333-339

Deemer,WL and Olkin,I (1951). The Jacobians of certain matrix transformations useful in multivariate analysis, *Biometrika*, **58**, 345 367.

Fairweather WR (1973). A test for multivariate normality based on a characterization. Dissertation submitted in partial fulfillment of the requirements for the Doctor of Philosophy, University of 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

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

```
## 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 equivalent simple ones, Rev. Int. Statist. Instit., 38, 351-368 Csorgo,M and Seshadri,V (1971). Characterizing the Gaussian and exponential laws by mappings onto the unit interval, Z. Wahrscheinlickhkeitstheorie verw. Geb., 18, 333-339. Fairweather, WR (1973). A test for multivariate normality based on a characterization. Dissertation submitted in partial fulfillment of the requirements for the Doctor of Philosophy, University of Washington, Seattle WA.

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.

Usage

```
data("unknown.Bp2")
```

Format

3600 x 2 x 1 array

Source

Generated by the author

Examples

```
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

```
data("unknown.Bp4")
```

Format

6000 x 4 x 1 array

Source

Generated by the author

Examples

```
data("unknown.Bp4")
```

---

unknown.Np2 *A Sample From an Unknown Bivariate Distribution*

Description

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

Usage

```
data("unknown.Np2")
```

Format

2500 x 2 matrix

Source

Generated by the author

Examples

```
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

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

Format

6000 x 4 x 1 array

Source

Generated by the author

Examples

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

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