# Package ‘Kurt’

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**Type** Package  
**Title** Performs Kurtosis-Based Statistical Analyses  
**Version** 1.0  
**Date** 2020-01-27

**Description** Computes measures of multivariate kurtosis, matrices of fourth-order moments and cumulants, kurtosis-based projection pursuit.  

**License** GPL (>= 2)  
**Author** Cinzia Franceschini [aut, cre], Nicola Loperfido [aut]  
**Maintainer** Cinzia Franceschini <cinziafranceschini@msn.com>  
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**R topics documented:**

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Kurt: Performs kurtosis-based statistical analyses

Description

Computes measures of multivariate kurtosis, matrices of fourth-order moments and cumulants, kurtosis-based projection pursuit

Details

Index of help topics:

- **Cum4**: fourth multivariate cumulant
- **ExtKur**: kurtosis based projection pursuit
- **ExtKurBiv**: kurtosis-based projection pursuit for bivariate random vectors
- **Fourth**: matrices of fourth moments or fourth cumulants
- **Fourth4**: fourth moment of a data matrix
- **Kurt-package**: Kurt: Performs kurtosis-based statistical analyses
- **NoKurt**: data projections whose excess kurtosis is as close to zero as possible
- **ScalarKurt**: ScalarKurt
- **optik**: optik

ScalarKurt(), ExtKurt(), ExtKurBiv(), optik(), NoKurt(), Cum4(), Fourth(), Fourth4()

Author(s)

Cinzia Franceschini and Nicola Loperfido

Maintainer: Cinzia Franceschini cinziafranceschini@msn.com

References


Cum4

Cum4: fourth multivariate cumulant

Description
returns a matrix containing the fourth cumulants of the given data

Usage
Cum4(data, type, shape)

Arguments

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<tr>
<td>data</td>
<td>data matrix</td>
</tr>
<tr>
<td>type</td>
<td>type=0 uses original data, type=1 uses centered data, type=2 uses standardized data</td>
</tr>
<tr>
<td>shape</td>
<td>if shape=&quot;square&quot; the output is a d^2 x d^2 matrix. If shape=&quot;rectangular&quot;, the output is a d x d^3 matrix. Where d is the number of variables</td>
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Value

$K_4$ is the matrix containing the fourth cumulants of the given data.

Author(s)

Cinzia Franceschini and Nicola Loperfido

Examples

data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
Cum4(iris[,1:4], 1, "square") # returns a matrix containing the fourth cumulants of the given data

---

**ExtKur**

ExtKur: kurtosis based projection pursuit

Description

Returns a data projection with either maximal or minimal kurtosis.

Usage

ExtKur(data, iterations, maxmin)

Arguments

data data matrix
iterations number of required iterations
maxmin is the choice to either maximise ("MAX") or minimise ("MIN") kurtosis

Value

linear vector of coefficients
projection vector of projected data
kurt extreme kurtosis attainable by a data projection

Author(s)

Cinzia Franceschini and Nicola Loperfido

Examples

data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
ExtKur(iris[,1:4],10,"MAX") #returns a data projection with maximal kurtosis
**ExtKurBiv**  

*ExtKurBiv: kurtosis-based projection pursuit for bivariate random vectors*

### Description

Returns a projection of bivariate data with either maximal or minimal kurtosis.

### Usage

`ExtKurBiv(data, maxmin)`

**Arguments**

- **data**: data matrix
- **maxmin**: choice between maximal ("MAX") and minimal ("MIN") kurtosis

### Value

- **linearMAX**: coefficients of the projections maximising kurtosis
- **projectionMAX**: projection with maximal kurtosis
- **kurtMAX**: maximal kurtosis
- **linearMIN**: coefficients of the projections minimising kurtosis
- **projectionMIN**: projection with minimal kurtosis
- **kurtMIN**: minimal kurtosis

### Author(s)

Cinzia Franceschini and Nicola Loperfido

### Examples

```r
data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode

ExtKurBiv(iris[,1:2],"MAX")# returns a projection of bivariate data with maximal kurtosis
```
Fourth matrices of fourth moments or fourth cumulants

Description

Returns a matrix containing either the fourth moments or the fourth cumulants. It recalls the functions Fourth4 and Cum4.

Usage

Fourth(data, type, shape, feature)

Arguments

data data matrix

type type =0 is the ordinary fourth moment / cumulant; type =1 is the centered fourth moment / cumulant; type =2 is the standardized fourth moment / cumulant

shape “square” or “rectangular”

feature “moment” or “cumulant”. If feature is "moment", the function computes the fourth moment of a data matrix. The function recalls the function Fourth4. If feature is "cumulant", the function computes the fourth multivariate cumulant. The function recalls the function Cum4.

Value

M Fourth square moment matrix

MM Fourth rectangular moment matrix

K4 Fourth cumulants of the given data

Author(s)

Cinzia Franceschini and Nicola Loperfido

Examples

data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
Fourth(iris[,1:4], 1,"square", "moment")#returns a matrix containing the fourth moments
Fourth4

Fourth: fourth moment of a data matrix

Description

Returns a matrix containing the fourth moments.

Usage

Fourth4(data, type, shape)

Arguments

data  data matrix

type  type=0 is the ordinary fourth moment, type=1 is the centered fourth moment,
type=2 is the standardized fourth moment

shape  "square" or "rectangular"

Value

M  Fourth square moment matrix

MM  Fourth rectangular moment matrix

Author(s)

Cinzia Franceschini and Nicola Loperfido

Examples

data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
Fourth4(iris[,1:4], 1,"square") #returns a matrix containing the fourth moments

NoKurt  NoKurt: data projections whose excess kurtosis is as close to zero as possible

Description

Data projections whose excess kurtosis is as close to zero as possible. Excess kurtosis is the fourth standardized cumulant, that is the fourth standardized moment minus three.

Usage

NoKurt(data, number)
Arguments

data  data matrix

number  number of required projections. It must be greater than one and less than the number of variables

Value

Nkurtoses  kurtoses of Nprojections
Nprojections  data projections ordered according to the absolute values of their excess kurtoses
MATRIX  matrix characterizing the projection

Author(s)

Cinzia Franceschini and Nicola Loperfido

Examples

```r
data(iris)
iris<-data.matrix(iris[,1:4])#returns the matrix obtained by converting the dframe to numeric mode
NoKurt(iris[,1:4],3)#returns data projections whose excess kurtosis is as close to zero as possible
```

Description

It computes the matrix containing the smallest and largest kurtoses of data projections as well as the corresponding directions.

Usage

```r
optik(data)
```

Arguments

data  data matrix

Value

kurMAX  kurtosis of the projection maximizing kurtosis
pMAX  projection maximizing kurtosis
dMAX  direction maximizing kurtosis
kurMINbis  kurtosis of the projection minimizing kurtosis
pMINbis  projection minimizing kurtosis
dMINbis  direction minimizing kurtosis
**Author(s)**

Cinzia Franceschini and Nicola Loperfido

**Examples**

```r
data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
optik(iris[,1:4])#starting values of the iteration aimed at finding projections with extreme kurtosis
```

---

**ScalarKurt**

**Description**

Returns the statistic and the p-value of either Mardia’s kurtosis or Koziol’s kurtosis tests for normality.

**Usage**

ScalarKurt(data, feature, type, prob)

**Arguments**

- `data`: data matrix
- `feature`: "moment" or "cumulant"
- `type`: "Mardia" or "Koziol"
- `prob`: "lower" if probability is P[X <= x], "upper" if probability is P[X > x], "twoside" if probability is computed on both tails

**Details**

For Koziol kurtosis only the upper tail is meaningful

**Value**

- `statistic`
- `pvalue`

**Author(s)**

Cinzia Franceschini and Nicola Loperfido

**Examples**

```r
data(iris)
iris<-data.matrix(iris)#returns the matrix obtained by converting the data frame to numeric mode
ScalarKurt(iris[,1:4],"moment","Mardia","upper")#values of Mardia's kurtosis test for normality
```
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