Package ‘OrdNor’

May 15, 2019

Type Package

Title Concurrent Generation of Ordinal and Normal Data with Given Correlation Matrix and Marginal Distributions

Version 2.2.1

Date 2019-05-14

Author Anup Amatya, Hakan Demirtas, Ran Gao

Maintainer Ran Gao <rgao8@uic.edu>

Depends mvtnorm, corpcor, Matrix, GenOrd

Imports stats

Description Implementation of a procedure for generating samples from a mixed distribution of ordinal and normal random variables with pre-specified correlation matrix and marginal distributions.

License GPL

NeedsCompilation no

Repository CRAN

Date/Publication 2019-05-14 22:00:10 UTC

R topics documented:

OrdNor-package ........................................... 2
ccmat.star ................................................... 2
genOrdNor .................................................. 3
IntermediateON ........................................... 5
IntermediateOO ............................................. 6
LimitforON .................................................. 7
LimitforOO .................................................. 8
ordinalize ................................................... 8
valid.limits ............................................... 9
validate.plist ............................................ 10
validate.target.cormat .................................. 10

Index 12
Description

The package implements a procedure for concurrently generating samples from ordinal and normal random variables with a pre-specified correlation matrix and marginal distributions. It is accomplished by first calculating an intermediate correlations (\texttt{cmat.star}) which is used to generate a sample from multivariate normal distribution. Then, the first few components (corresponding to number of ordinal variables) are ordinalized. The resulting data are composed of a mixture of ordinal and normal variables that conform with a pre-specified marginal distributions and correlation structure. The function \texttt{valid.limits} returns the lower and upper bounds of the correlation coefficients of ordinal-ordinal (OO) and ordinal-normal (ON) pairs given their marginal distributions, i.e. returns the range of feasible pairwise correlations. The function \texttt{validate.target.cormat} checks the validity of the values of pairwise correlations. Additionally, it checks positive definiteness, symmetry and correct dimension. The engine function \texttt{genOrdNor} generates mixed data in accordance with the specified marginal and correlational quantities.

Details

\begin{verbatim}
Package: OrdNor
Type: Package
Version: 2.2.1
Date: 2019-05-14
License: GPL
\end{verbatim}

Author(s)

Anup Amatya, Hakan Demirtas, Ran Gao
Maintainer: Ran Gao <rgao8@uic.edu>

\begin{verbatim}
cmat.star
\end{verbatim}

Description

The function computes an intermediate correlation matrix which leads to the target correlation matrix after ordinalization of the samples generated from a multivariate normal distribution with the intermediate correlation matrix.
Usage

cmat.star(plist, CorrMat, no.ord, no.norm)

Arguments

- **plist**: A list of probability vectors corresponding to each ordinal variable. The i-th element of plist is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the plist will contain k-1 probability values. The k-th element is implicitly 1.
- **CorrMat**: The target correlation matrix which must be positive definite and within the valid limits.
- **no.ord**: Number of ordinal variables in the data.
- **no.norm**: Number of normal variables in the data.

Value

An intermediate correlation matrix of size \((\text{no.ord} + \text{no.norm}) \times (\text{no.ord} + \text{no.norm})\)

See Also

- **validate.target.cormat**

Examples

```R
Sigma = diag(4)
Sigma[lower.tri(Sigma)] = c(0.42, 0.78, 0.29, 0.37, 0.14, 0.26)
Sigma = Sigma + t(Sigma)
diag(Sigma)=1
marginal = list( c(0.2, 0.5), c(0.4, 0.7, 0.9))
cmat.star(marginal, Sigma, 2, 2)
```

### genOrdNor

Generates a data set with ordinal and normal variables

Description

The function simulates a data set with ordinal and normal components with a pre-specified correlation matrix and marginals.

Usage

genOrdNor(n, plist, cmat.star, mean.vec, sd.vec, no.ord, no.norm)
Arguments

- **n**: Number of rows
- **plist**: A list of probability vectors corresponding to each ordinal variable. The i-th element of `plist` is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the `plist` will contain k-1 probability values. The k-th element is implicitly 1.
- **cmat.star**: The intermediate correlation matrix obtained from `cmat.star` function.
- **mean.vec**: A vector of means for the normal variables.
- **sd.vec**: A vector of standard deviations for the normal variables.
- **no.ord**: Number of ordinal variables.
- **no.norm**: Number of normal variables.

Value

A matrix of size $n \times (\text{no.ord} + \text{no.norm})$, of which first `no.ord` are ordinal variables.

References


See Also

- `cmat.star`
- `validate.target.cormat`
- `validate.plist`

Examples

```r
Sigma = diag(4)
Sigma[lower.tri(Sigma)] = c(0.42, 0.78, 0.29, 0.37, 0.14, 0.26)
Sigma = Sigma + t(Sigma)
diag(Sigma) = 1

marginal = list(c(0.2, 0.5), c(0.4, 0.7, 0.9))
cmat = cmat.star(marginal, Sigma, 2, 2)
mean.vec = c(2, 4)
sd.vec = c(0.5, 1.5)
Y = genOrdNor(10000, marginal, cmat, mean.vec, sd.vec, 2, 2)
cor(Y)
```
IntermediateON

Computes intermediate correlations for ordinal-normal pairs before ordinalization

Description

The function computes the intermediate correlation values of pairwise correlations between ordinal and normal variables.

Usage

IntermediateON(plist, ONCorrMat)

Arguments

plist
A list of probability vectors corresponding to each ordinal variable. The i-th element of plist is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the plist will contain k-1 probability values. The k-th element is implicitly 1.

ONCorrMat
A matrix of pairwise target correlations between ordinal and normal variables. This is a submatrix of the overall correlation matrix, and it is pertinent to the ordinal-normal part. Hence, the matrix may or may not be square. Even when it is square, it may not be symmetric.

Value

A pairwise correlation matrix of intermediate correlations.

See Also

IntermediateOO, cmat.star

Examples

```r
no.ord=3
do.nrm =4
n = 200
q=no.ord + do.nrm
set.seed(12345)

Sigma = diag(q)
Sigma[lower.tri(Sigma)] = runif( (q*(q-1))/2,-0.4,0.4 )
Sigma = Sigma + t(Sigma)
diag(Sigma)=1
Sigma=as.matrix( nearPD(Sigma,corr = TRUE, keepDiag = TRUE)$mat )

marginal = list( 0.3, cumsum( c(0.30, 0.40) ), cumsum(c(0.4, 0.2, 0.3)) )
```
IntermediateOO

Computes intermediate correlations for ordinal-ordinal pairs before ordinalization

Description

This function computes the correlation of normal-normal pairs before ordinalizing both components.

Usage

IntermediateOO(plist, OOCorrMat)

Arguments

plist
A list of probability vectors corresponding to each ordinal variable. The i-th element of plist is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the plist will contain k-1 probability values. The k-th element is implicitly 1.

OOCorrMat
A matrix of pairwise target correlations between ordinal variables. It is a symmetric square matrix whose diagonal elements are 1.

Value

A pairwise correlation matrix of intermediate correlations for ordinal variables.

See Also

IntermediateON, cmat.star

Examples

```r
no.ord=3	no.norm =4
n = 200
q=no.ord + no.norm
set.seed(12345)

Sigma = diag(q)
Sigma[lower.tri(Sigma)] = runif( (q*(q-1)/2),-0.4,0.4 )
Sigma = Sigma + t(Sigma)
diag(Sigma)=1
Sigma=as.matrix( nearPD(Sigma,corr = TRUE, keepDiag = TRUE)$mat )
```
LimitforON

Finds the feasible correlation range for a pair of ordinal and normal variable

Description

The function computes the lower and upper bounds of a pairwise correlation between an ordinal and a normal variable via the method of Demirtas and Hedeker (2011).

Usage

```r
LimitforON(pvec1)
Limit_forON(pvec1) #deprecated
```

Arguments

- `pvec1`: A vector of marginal probabilities for an ordinal variable of the pair.

Value

A vector of two elements. The first element is the lower bound and the second element is the upper bound.

References


Examples

```r
marginal = list(0.3, cumsum(c(0.30, 0.40)), cumsum(c(0.4, 0.2, 0.3)))
OOCorrMat = Sigma[1:3, 1:3]
IntermediateOO(marginal, OOCorrMat)

pvec1 = cumsum(c(0.30, 0.40))
LimitforON(pvec1)
```
LimitforOO

Finds the feasible correlation range for a pair of ordinal variables

Description

The function computes the lower and upper bounds of correlation between two ordinal variables via the method of Demirtas and Hedeker (2011).

Usage

LimitforOO(pvec1, pvec2)
Limit_forOO(pvec1, pvec2) #deprecated

Arguments

pvec1 A vector of marginal probabilities for the first ordinal variable.
pvec2 A vector of marginal probabilities for the second ordinal variable.

Value

A vector of two elements. The first element is the lower bound and the second element is the upper bound.

References


Examples

pvec1 = cumsum(c(0.30, 0.40))
pvec2=cumsum(c(0.4, 0, 0.3)) # The second category is skipped in this setting
LimitforOO(pvec1, pvec2)

ordinalize

Ordinalizes the standard normal variable

Description

The function transforms the standard normal variable to an ordinal variable with a specified probability for each category.

Usage

ordinalize(pvec, z)
Arguments

- **pvec**
  A vector of probabilities for an ordinal variable. The i-th element of the pvec is the cumulative probability defining the marginal distribution of the ordinal variable. If the variable has k categories, the i-th element of pvec will contain k-1 probabilities. The k-th element is implicitly 1.

- **z**
  A vector of samples from the standard normal distribution.

Value

A vector of ordinalized variates.

---

**valid.limits**

*Computes the lower and upper bounds of correlation in the form of two matrices*

**Description**

The function computes the lower and upper bounds for the target correlation based on the marginal probabilities.

**Usage**

`valid.limits(plist, no.ord, no.norm)`

**Arguments**

- **plist**
  A list of probability vectors corresponding to each ordinal variable. The i-th element of plist is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the plist will contain k-1 probability values. The k-th element is implicitly 1.

- **no.ord**
  Number of ordinal variables.

- **no.norm**
  Number of normal variables.

**Details**

The function returns a list of two matrices. The lower contains the lower bounds and the upper contains the upper bounds of the feasible correlations.

**Examples**

```r
marginal = list(c(0.2, 0.5), c(0.4, 0.7, 0.9))
valid.limits(marginal, 2, 2)
```
validate.plist \hspace{1cm} Checks the validity of ordinal probabilities

Description

The function checks the validity of the probability vectors of the ordinal variables. It verifies that the elements in the vectors are cumulative probabilities and the values are between 0 and 1. It also checks a number of vectors within the list matches the specified number of ordinal variables.

Usage

validate.plist(plist, no.ord)

Arguments

\begin{itemize}
\item \texttt{plist} \hspace{2cm} A list of probability vectors corresponding to each ordinal variable. The i-th element of \texttt{plist} is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the \texttt{plist} will contain k-1 probability values. The k-th element is implicitly 1.
\item \texttt{no.ord} \hspace{2cm} Number of ordinal variables.
\end{itemize}

Details

The function returns error message if there are any violations. No message is displayed for the correct specifications.

Examples

\begin{verbatim}
marginal = list( c(0.2, 0.5), c(0.4, 0.7, 0.9))
validate.plist(marginal, 2)\end{verbatim}

validate.target.cormat \hspace{1cm} Checks the target correlation matrix

Description

The function checks the validity of the values of pairwise correlations. Additionally, it checks positive definitiveness, symmetry and correct dimension.

Usage

validate.target.cormat(plist, CorrMat, no.ord, no.norm)
validate.target.cormat

Arguments

plist  A list of probability vectors corresponding to each ordinal variable. The i-th element of plist is a vector of the cumulative probabilities defining the marginal distribution of the i-th ordinal component of the multivariate variables. If the i-th ordinal variable has k categories, the i-th vector of the plist will contain k-1 probability values. The k-th element is implicitly 1.

CorrMat  The target correlation matrix which must be positive definite and within the valid limits.

no.ord  Number of ordinal variables.

no.norm  Number of normal variables.

Details

In addition to being positive definite and symmetric, the values of pairwise correlations in the target correlation matrix must also fall within the limits imposed by the marginal distributions of the ordinal variables. The function ensures that the supplied correlation matrix is valid for simulation. If a violation occurs, an error message is displayed that identifies the violation. The function returns a logical value TRUE when no such violation occurs.

Examples

Sigma = diag(4)
Sigma[lower.tri(Sigma)] = c(0.42, 0.78, 0.29, 0.37, 0.14, 0.26)
Sigma = Sigma + t(Sigma)
diag(Sigma)=1

marginal = list( c(0.2, 0.5), c(0.4, 0.7, 0.9))
validate.target.cormat(marginal, Sigma, 2,2)
Index

cmat.star, 2, 2, 4–6

genOrdNor, 2, 3

IntermediateON, 5, 6
IntermediateOO, 5, 6

Limit_forON (LimitforON), 7
Limit_forOO (LimitforOO), 8
LimitforON, 7
LimitforOO, 8

ordinalize, 8
OrdNor (OrdNor-package), 2
OrdNor-package, 2

valid.limits, 2, 9
validate.plist, 4, 10
validate.target.cormat, 2–4, 10