Package ‘MultiVarMI’

October 12, 2022

Type Package
Title Multiple Imputation for Multivariate Data
Version 1.0
Date 2018-04-08
Author Rawan Allozi, Hakan Demirtas
Maintainer Rawan Allozi <ralloz2@uic.edu>
License GPL-2 | GPL-3
Imports BinOrdNonNor, CorrToolBox, corpcor, Matrix, moments, norm, PoisNonNor
Suggests PoisBinOrdNonNor
NeedsCompilation no
Repository CRAN
Date/Publication 2018-04-09 11:55:15 UTC

R topics documented:

MultiVarMI-package .................................................. 2
countrate ................................................................. 3
MI ................................................................. 4
MVN.corr .............................................................. 6
MVN.dat ............................................................... 9
nctsum ............................................................... 10
ordmps ................................................................. 12
trMVN.dat ............................................................ 13

Index 15
Description

This package implements a Bayesian multiple imputation framework for multivariate data. Most incomplete data sets consist of interdependent binary, ordinal, count, and continuous data. Furthermore, planned missing data designs have been developed to reduce respondent burden and lower the cost associated with data collection. The unified, general-purpose multiple imputation framework described in Demirtas (2017) can be utilized in developing power analysis guidelines for intensive multivariate data sets that are collected via increasingly popular real-time data capture (RTDC) approaches. This framework can accommodate all four major types of variables with a minimal set of assumptions. The data are prepared for multivariate normal multiple imputation for use in the norm package and subsequently backtransformed to the original distribution.

This package consists of one main function and six auxiliary functions. Multiple imputation can be performed using the function MI. While the auxiliary functions are utilized in MI, they can be used as stand-alone functions. nctsum outputs a list with summary statistics and Fleishman coefficients and standardized forms of each variable. ordmps is utilized for ordinal variables and outputs a list with empirical marginal probabilities and the associated observations for each ordinal variable. countrate is designed for variables and outputs a list with empirical rates and the associated observations for each ordinal variable. MWN.corr calculates the intermediate correlation matrix, MWN.dat transforms variables to a standard normal variable, and trMWN.dat transforms standard normal variables to ordinal, count, and/or non-normal continuous variables through specified parameters.

Details

- **Package:** MultiVarMI
- **Type:** Package
- **Version:** 1.0
- **Date:** 2018-04-08
- **License:** GPL-2 | GPL-3

Author(s)

Rawan Allozi, Hakan Demirtas

Maintainer: Rawan Allozi <ralloz2@uic.edu>

References


countrate

---

### countrate

**Computation of Rates for Count Data**

**Description**

This function computes the empirical rates for count data.

**Usage**

```r
countrate(count.dat)
```

**Arguments**

- `count.dat` A matrix consisting of count variables.

**Value**

A list of length `ncol(count.dat)` containing the data and empirical rates for each variable in `count.dat`.

**See Also**

`MI`, `MVN.corr`
MI

Bayesian Multiple Imputation for Multivariate Data

Description

This function implements the multiple imputation framework as described in Demirtas (2017) “A multiple imputation framework for massive multivariate data of different variable types: A Monte-Carlo technique.”

Usage

MI(dat, var.types, m)

Arguments

dat A data frame containing multivariate data with missing values.
var.types The variable type corresponding to each column in dat, taking values of "NCT" for continuous data, "O" for ordinal or binary data, or "C" for count data.
m The number of stochastic simulations in which the missing values are replaced.

Value

A list containing m imputed data sets.
References


See Also

*MVN.corr, MVN.dat, trMVN.dat*

Examples

```r
library(PoisBinOrdNonNor)
set.seed(1234)
n<-1e5
lambdas<-list(1, 3) #2 count variables
mps<-list(c(.2, .8), c(.6, 0, .3, .1)) #1 binary variable, 1 ordinal variable with skip pattern
moms<-list(c(-1, 1, 0, 1), c(0, 3, 0, 2)) #2 continuous variables

############################################################
#Generate Poisson, Ordinal, and Continuous Data#
############################################################
#get intermediate correlation matrix
cmat.star <- find.cor.mat.star(cor.mat = .8 * diag(6) + .2, #all pairwise correlations set to 0.2
                                no.pois = length(lambdas),
                                no.ord = length(mps),
                                no.nonn = length(moms),
                                pois.list = lambdas,
                                ord.list = mps,
                               )
```
nonn.list = moms)

#generate dataset
mydata <- genPBONN(n,
   no.pois = length(lambdas),
   no.ord = length(mps),
   no.nonn = length(moms),
   cmat.star = cmat.star,
   pois.list = lambdas,
   ord.list = mps,
   nonn.list = moms)

cor(mydata)
apply(mydata, 2, mean)

#Make 10 percent of each variable missing completely at random
mydata<-apply(mydata, 2, function(x) {
  x[sample(1:n, size=n*0.1)]<-NA
  return(x)
})

#Create 5 imputed datasets
mydata<-data.frame(mydata)
mymidata<-MI(dat=mydata,
   var.types=c('C', 'C', '0', '0', 'NCT', 'NCT'),
   m=5)

#get the means of each variable for the m imputed datasets
do.call(rbind, lapply(mymidata, function(x) apply(x, 2, mean)))

#get m correlation matrices of for the m imputed dataset
lapply(mymidata, function(x) cor(x))

#Look at the second imputed dataset
head(mymidata$dataset2)

##run a linear model on each dataset and extract coefficients
mycoef<-lapply(mymidata, function(x) {
  fit<-lm(X6~., data=data.frame(x))
  fit.coef<-coef(fit)
  return(fit.coef)
})

do.call(rbind, mycoef)
**Description**

This function calculates an intermediate correlation matrix for Poisson, ordinal, and continuous random variables, with specified target correlations and marginal properties.

**Usage**

```r
MVN.corr(indat, var.types, ord.mps=NULL, nct.sum=NULL, count.rate=NULL)
```

**Arguments**

- `indat` A data frame containing multivariate data. Continuous variables should be standardized.
- `var.types` The variable type corresponding to each column in `dat`, taking values of "NCT" for continuous data, "O" for ordinal or binary data, or "C" for count data.
- `ord.mps` A list containing marginal probabilities for binary and ordinal variables as packaged from output in `ordmps`. Default is `NULL`.
- `nct.sum` A matrix containing summary statistics for continuous variables as packaged from output in `nctsum`. Default is `NULL`.
- `count.rate` A vector containing rates for count variables as packaged from output in `countrate`. Default is `NULL`.

**Value**

The intermediate correlation matrix.

**References**


See Also

MI, MVN.dat, ordmps, nctsum, countrate

Examples

library(PoisBinOrdNonNor)

n<-1e4
lambdas<-list(1, 3)
mps<-list(c(.2, .8), c(.6, 0, .3, .1))
moms<-list(c(-1, 1, 0, 1), c(0, 3, 0, 2))

#generate Poisson, ordinal, and continuous data
cmat.star <- find.cor.mat.star(cor.mat = .8 * diag(6) + .2,
                                 no.pois = length(lambdas),
                                 no.ord = length(mps),
                                 no.nonn = length(moms),
                                 pois.list = lambdas,
                                 ord.list = mps,
                                 nonn.list = moms)

mydata <- genPBONN(n,
                    no.pois = length(lambdas),
                    no.ord = length(mps),
                    no.nonn = length(moms),
                    cmat.star = cmat.star,
                    pois.list = lambdas,
                    ord.list = mps,
                    nonn.list = moms)

#set a sample of each variable to missing
mydata<-apply(mydata, 2, function(x) {
  x[sample(1:n, size=n/10)]<-NA
  return(x)
})

mydata<-data.frame(mydata)

#get information for use in function
ord.info<-ordmps(ord.dat=mydata[,c('X3', 'X4')])
nct.info<-nctsum(nct.dat=mydata[,c('X5', 'X6')])
count.info<-countrate(count.dat=mydata[,c('X1', 'X2')])

#extract marginal probabilities, continuous properties, and count rates
mps<-sapply(ord.info, "[[", 2)
nctsum<-sapply(nct.info, "[[", 2)
rates<-sapply(count.info, "[[", 2)

#replace continuous with standardized forms
mydata[,c('X5', 'X6')]<-sapply(nct.info, "[[", 1)[,c('X5', 'X6')]

var.types<-c('C', 'C', 'O', 'O', 'NCT', 'NCT')
mvn.cmat<-MVN.corr(indat=mydata,
    var.types=var.types,
    ord.mps=mps,
    nct.sum=nctsum,
    count.rate=rates)

MVN.dat  Computation of Normal Scores for Multivariate Data

Description

This function assigns a normal score to binary and ordinal variables using normal quantiles in this
appropriate range dictated by marginal proportions; a normal score to count variables based on the
equivalence of CDFs of Poisson and normal distribution in the appropriate range dictated by the
rate parameters; and a normal score for each continuous measurement by finding the normal root in
the Fleishman equation.

Usage

MVN.dat(ord.info=NULL, nct.info=NULL, count.info=NULL)

Arguments

ord.info   A list containing binary and ordinal data and corresponding marginal probabili-
            ties as packaged in ordmps. Default is NULL.

nct.info   A list containing standardized continuous data and corresponding summary statist-
            ics for continuous variables as packaged in nctsum. Default is NULL.

count.info A list containing count data and corresponding rates as packaged in countrate.
            Default is NULL.

Value

A matrix containing normal scores for each variable input.

References

521-532.

See Also

MI, ordmps, nctsum, countrate
Examples

```r
library(PoisBinOrdNonNor)

n <- 1e4

lambdas <- list(1)
myps <- list(c(.2, .8))
moms <- list(c(-1, 1, 0, 1))

# generate Poisson, ordinal, and continuous data

cmat.star <- find.cor.mat.star(cor.mat = .8 * diag(3) + .2,
                                 no.pois = length(lambdas),
                                 no.ord = length(myps),
                                 no.nonn = length(moms),
                                 pois.list = lambdas,
                                 ord.list = myps,
                                 nonn.list = moms)

mydata <- genPBONN(n,
                    no.pois = length(lambdas),
                    no.ord = length(myps),
                    no.nonn = length(moms),
                    cmat.star = cmat.star,
                    pois.list = lambdas,
                    ord.list = myps,
                    nonn.list = moms)

# set a sample of each variable to missing

mydata <- apply(mydata, 2, function(x) {
    x[sample(1:n, size = n/10)] <- NA
    return(x)
})

mydata <- data.frame(mydata)

# get information for use in function

count.info <- countrate(count.dat = data.frame(mydata[, c('X1')]))
ord.info <- ordmps(ord.dat = data.frame(mydata[, c('X2')]))
nct.info <- nctsum(nct.dat = data.frame(mydata[, c('X3')]))

mvn.dat <- MVN.dat(ord.info = ord.info,
                   nct.info = nct.info,
                   count.info = count.info) # outputs in order of continuous, ordinal, count
```

nctsum  
Summary and Standardization of Continuous Data

Description

This function calculates mean, variance, skewness, excess kurtosis, and Fleishman coefficients for continuous data and also standardizes each variable.
Usage
nctsum(nct.dat)

Arguments
nct.dat A data frame consisting of continuous variables.

Value
A list of length ncol(nct.dat) containing the standardized data and summary statistics for each variable in nct.dat.

References

See Also
MI, MVN.corr

Examples
library(PoisBinOrdNonNor)
set.seed(123)
n<1e4

#first four moments for each simulated variable
moms<-list(c(-1, 1, 0, 1), c(0, 3, 0, 2))

#generate continuous data
cmat.star <- find.cor.mat.star(cor.mat = .8 * diag(2) + .2,
no.nonn = 2,
nonn.list = moms)

nctdata <- genPBONN(n,
no.nonn = length(moms),
cmat.star = cmat.star,
nonn.list = moms)

#set a sample of each variable to missing
nctdata<-apply(nctdata, 2, function(x) {
  x[sample(1:n, size=n/10)]<-NA
  return(x)
})

nctdata<-data.frame(nctdata)
nctinfo<-nctsum(nctdata)
Description

This function computes the empirical marginal probabilities for binary and ordinal data.

Usage

ordmps(ord.dat)

Arguments

ord.dat  A data frame consisting of binary and ordinal variables.

Value

A list of length ncol(ord.dat) containing the data and empirical marginal probabilities for each variable in ord.dat.

See Also

MI, MVN.corr

Examples

library(PoisBinOrdNonNor)
set.seed(123)
n<-1e4
mps<-list(c(.2, .8), c(.6, 0, .3, .1))

#generate ordinal data
cmat.star <- find.cor.mat.star(cor.mat = .8 * diag(2) + .2,
                                  no.ord = length(mps),
                                  ord.list = mps)

orddata <- genPBONN(n,
                     no.ord = length(mps),
                     cmat.star = cmat.star,
                     ord.list = mps)

#set a sample of each variable to missing
orddata<-apply(orddata, 2, function(x) {
  x[sample(1:n, size=n/10)]<-NA
  return(x)
})

orddata<-data.frame(orddata)
ordinfo<-ordmps(orddata)
Description

This function backtransforms normal scores for ordinal variables using the thresholds determined by the marginal proportions using quantiles of the normal distribution; normal scores for continuous variables by the sum of linear combinations of standard normals using the corresponding Fleishman coefficients; and normal scores for count variables by the inverse cdf matching procedure.

Usage

trMVN.dat(indat, ord.mps=NULL, nct.sum=NULL, count.rate=NULL)

Arguments

indat A list of data frames of normal scores to be backtransformed.
ord.mps A list containing marginal probabilities for binary and ordinal variables as packaged from output in ordmps. Default is NULL.
nct.sum A matrix containing summary statistics for continuous variables as packaged from output in nctsum. Default is NULL.
count.rate A vector containing rates for count variables as packaged from output in countrate. Default is NULL.

Value

A list containing backtransformed data.

References


See Also

MI, ordmps, nctsum, countrate

Examples

sndat<-data.frame(matrix(rnorm(1e4), ncol=5, nrow=1e4/5))

# ordinal marginal probabilities
m1<-c(0.4, 0.6)
names(m1)<-c(0,1)
m2<-c(0.2, 0.3, 0.5)
names(m2)<-c(0,2,3)
mps<-list(X1=m1, X2=m2)

trMVN.dat(sndat, mps)

trMVN.dat(sndat, mps, count.rate=rep(0, 5))

trMVN.dat(sndat, mps, count.rate=rep(c(0, 0.1), each=5))
# count rates
rates<-c(2, 3)
names(rates)<-c('X3', 'X4')

# continuous
ncsum<-data.frame(X5=c(1, 1, -0.31375, 0.82632, 0.31375, 0.02271)) # Weibull(1, 1)
rownames(ncsum)<-c('Mean', 'Variance', 'a', 'b', 'c', 'd')

trdat<-trMVN.dat(indat=list(sndat), ord.mps=mps, nct.sum=ncsum, count.rate=rates)
Index

countrate, 2, 3, 8, 9, 13

MI, 2, 3, 4, 8, 9, 11–13
MultiVarMI (MultiVarMI-package), 2
MultiVarMI-package, 2
MVN.corr, 2, 3, 5, 6, 11, 12
MVN.dat, 2, 5, 8, 9

nctsum, 2, 8, 9, 10, 13

ordmps, 2, 8, 9, 12, 13

trMVN.dat, 2, 5, 13