Package 'PMD'

August 5, 2021

Type Package

Title Computation of Poisson-Multinomial Distribtuions

Version 1.0

Date 2021-08-06

Maintainer Yili Hong <yilihong@vt.edu>

Description Applying exact, simulation and approximation methods for computing probability mass functions, cumulative distribution functions of Poisson-Multinomial distributions together with a random number generator to conduct Poisson-Multinomial distribution sampling. The exact method is based on fast Fourier transformation of the characteristic functions of Poisson-Multinomial distributions. Simulation method is built via naive sampling scheme of different multinomial distributions. Approximation method is designed by asymptotic distrbutions of Poisson-Multinomial distributions, which are normal.

License GPL (>= 2)

Encoding UTF-8

Imports mvtnorm, Rcpp

LinkingTo Rcpp, RcppArmadillo

SystemRequirements fftw3(>=3.3)

RoxygenNote 7.1.1

NeedsCompilation yes

Author Yili Hong [aut, ctb],
Zhengzhi Lin [aut, cre],
Yueyao Wang [aut, ctb]

R topics documented:

dpmd 2
ppmd 3
rpmd 3

Index **4**

dpmd *Probability Mass of Poisson-Multinomial Distributions*

Description

Computation of probability mass for Poisson-Multinomial Distributions using exact, simulation, approximation methods. Users are allowed to specified a method and can choose to compute single mass point or all mass points. For simulation method, users can also choose the repeating time to enhance the accuracy of outcomes.

Usage

```
dpmd(pp, method = "DFT-CF", vec = c(0, 0, 0, 0, 0), B = 100)
```

Arguments

pp	A matrix of probabilities. Each row of pp should add up to 1.
method	Method selected by user to compute the probability mass. There are totally 4 methods. "DFT-CF": An exact method to calculate all probability mass points of Poisson-Multinomial Distributions via FFT algorithm. "simulation": A simulation method calculating all probability mass points. "NA by demands": An approximation method using Normal approximation to compute the probability for the 'vec' vector input by user. "simulation by demands": The same simulation method as above just to compute single probability mass point as input by user.
vec	Result vector(probability mass point) specified by user. eg. pp is 4 by 3 matrix then a user might be interested in the probability of getting result: vec=c(0,0,1,2).
B	Simulation repeat time.

Value

For a single mass point, dpmd returns a probability. For all probability mass points of a given pp, it returns a multi-dimensional array. For instance, for the pp matrix in the following example, the value of the array element $a_{1,2,1}$ = 0.90 means the value of probability mass point (0,1,0,2) is 0.90.

Examples

```
pp=matrix(c(.1, .1, .1, .7, .1, .3, .3, .3, .5, .2, .1, .2), nrow=3, byrow=TRUE)
dpmd(pp)
dpmd(pp,"simulation",B=10^3)
dpmd(pp,"NA by demands", vec = c(0,0,1,2))
dpmd(pp,"simulation by demands", vec = c(0,0,1,2), B=10^3)
```

ppmd *cumulative distribution function of PMN*

Description

By an input vector x = $(x_1, x_2, ...)$, this function compute $P(X_1 \leq x_1, X_2 \leq x_2, ...)$.

Usage

```
ppmd(pp, x, method = "DFT-CF", B = 1000)
```

Arguments

pp	input matrix of probabilities
x	input result vector
method	method selected by users to compute the cumulative mass probabilities.
B	repeating time

Value

cumulative distribution of given pp.

Examples

```
pp=matrix(c(.1, .1, .1, .7, .1, .3, .3, .3, .5, .2, .1, .2), nrow=3, byrow=TRUE)
ppmd(pp,c(3,2,1,3))
ppmd(pp,c(3,2,1,3),"simulation",B=10^3)
ppmd(pp,c(3,2,1,3),"NA")
```

rpmd *generate random number from PMD*

Description

generate random number from PMD

Usage

```
rpmd(pp)
```

Arguments

pp	input matrix of probabilities

Value

the random number vector generated from PMD.

Examples

```
pp=matrix(c(.1, .1, .1, .7, .1, .3, .3, .3, .5, .2, .1, .2), nrow=3, byrow=TRUE)
rpmd(pp)
```

Index

dpmd, 2

ppmd, 3

rpmd, 3