Package ‘RNGforGPD’

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Type Package

Title Random Number Generation for Generalized Poisson Distribution

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Description Generation of univariate and multivariate data that follow the generalized Poisson distribution. The details of the univariate part are explained in Demirtas (2017), and the multivariate part is an extension of the correlated Poisson data generation routine that was introduced in Yahav and Shmueli (2012).

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LazyData true

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Depends R (>= 3.5.0)

Imports VGAM, corpcor, mvtnorm, Matrix

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VignetteBuilder knitr

Collate 'GenUniGpois.R' 'CorrNNGpois.R' 'ComputeCorrGpois.R' 'ValidCorrGpois.R' 'CmatStarGpois.R' 'QuantileGpois.R' 'GenMVGPois.R' 'RNGforGPD-package.R'

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`RNGforGPD-package` *Generates Univariate and Multivariate Generalized Poisson Variables*

Description

This package is about generating univariate and multivariate data that follow the generalized Poisson distribution.There are seven functions in the package: `GenUniGpois` and `GenMVGpois` are the data generation functions that simulate univariate and multivariate Poisson variables, respectively; `ValidCorrGpois` checks the validity of the values of pairwise correlations; `ComputeCorrGpois` computes the lower and upper correlation bounds of a pairwise correlation between a pair of generalized Poisson variables; `CorrNNGpois` adjusts the target correlation for a pair of generalized Poisson variables; `QuantileGpois` computes the quantile of a given generalized Poisson distribution; `CmatStarGpois` computes an intermediate correlation matrix. To learn more about this package please refer to both the reference manual and the vignette file.

Details

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License:	GPL-2 | GPL-3

Author(s)

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References

Amatya, A. and Demirtas, H. (2015). Simultaneous generation of multivariate mixed data with Poisson and normal marginals. *Journal of Statistical Computation and Simulation*, **85(15)**, 3129-3139.

Amatya, A. and Demirtas, H. (2017). PoisNor: An R package for generation of multivariate data with Poisson and normal marginals. *Communications in Statistics - Simulation and Computation*, **46(3)**, 2241-2253.

Demirtas, H. (2017). On accurate and precise generation of generalized Poisson variates. *Communications in Statistics - Simulation and Computation*, **46(1)**, 489-499.

Demirtas, H. and Hedeker, D. (2011). A practical way for computing approximate lower and upper correlation bounds. *The American Statistician*, **65(2)**, 104-109.

Yahav, I. and Shmueli, G. (2012). On generating multivariate Poisson data in management science applications. *Applied Stochastic Models in Business and Industry*, **28(1)**, 91-102.

`CmatStarGpois` *Computes Intermediate Correlation Matrix*

Description

`CmatStarGpois` computes an intermediate correlation matrix that will be used to obtain the target correlation matrix using the inverse CDF transformation method in `GenMVGpois`. If the intermediate correlation martrix is not positive definite, the nearest positive definite matrix is used.

Usage

```
CmatStarGpois(corMat, theta.vec, lambda.vec)
```

Arguments

`corMat`	target correlation matrix.
`theta.vec`	theta.vec rate parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two, and each value has to be a positive number.
`lambda.vec`	dispersion parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two. All lambda values have to be < 1. For lambda < 0, lambda must be >= -theta/4.

Value

intermediate correlation matrix.

References

Yahav, I. and Shmueli, G. (2012). On generating multivariate Poisson data in management science applications. *Applied Stochastic Models in Business and Industry*, **28(1)**, 91-102.

Examples

```
lambda.vec = c(-0.2, 0.2, -0.3)
theta.vec = c(1, 3, 4)
M = c(0.352, 0.265, 0.342)
N = diag(3)
N[lower.tri(N)] = M
```

```
TV = N + t(N)
diag(TV) = 1
cstar = CmatStarGpois(TV, theta.vec, lambda.vec)
cstar
```

ComputeCorrGpois *Computes the Lower and Upper Correlation Bounds*

Description

ComputeCorrGpois computes the lower and upper correlation bounds of a pairwise correlation between any pair of generalized Poisson variables using the Generate, Sort, and Correlate (GSC) algorithm described in Demirtas and Hedeker (2011).

Usage

```
ComputeCorrGpois(theta.vec, lambda.vec)
```

Arguments

theta.vec	rate parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two, and each value has to be a positive number.
lambda.vec	dispersion parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two. All lambda values have to be < 1. For lambda < 0, lambda must be >= -theta/4.

Value

lower and upper correlation bounds.

References

Demirtas, H. and Hedeker, D. (2011). A practical way for computing approximate lower and upper correlation bounds. *The American Statistician*, **65(2)**, 104-109.

Examples

```
ComputeCorrGpois(c(3,2,5,4),c(0.3,0.2,0.5,0.6))
ComputeCorrGpois(c(4,5),c(-0.45,-0.11))
```

CorrNNGpois *Adjusts the Target Correlation*

Description

CorrNNGpois adjusts the actual/realized correlation to the target correlation bounds for a pair of generalized Poisson variables.

Usage

```
CorrNNGpois(theta.vec, lambda.vec, r)
```

Arguments

theta.vec	rate parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two, and each value has to be a positive number.
lambda.vec	dispersion parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two. All lambda values have to be < 1. For lambda < 0, lambda must be >= -theta/4.
r	desired target correlation.

Value

the adjusted target correlation.

References

Yahav, I. and Shmueli, G.(2012), On generating multivariate Poisson data in management science applications. *Applied Stochastic Models in Business and Industry*, **28(1)**, 91-102.

Examples

```
CorrNNGpois(c(0.1,10), c(0.1, 0.2),0.5)
CorrNNGpois(c(0.1,10), c(-0.01, -0.02),0.5)
CorrNNGpois(c(4,2.3), c(-0.32,-0.3),0.7)
CorrNNGpois(c(14,10), c(-0.8, -0.3),0.99)
```

GenMVGpois *Generates Data from Multivariate Generalized Poisson Distribution*

Description

GenMVGpois simulates a sample of size *sample.size* from a set of multivariate generalized Poisson variables with correlation matrix *cmat.star* and pre-specified marginals.

Usage

```
GenMVGpois(sample.size, no.gpois, cmat.star, theta.vec, lambda.vec,
  details = TRUE)
```

Arguments

sample.size	desired sample size (number of rows) for the multivariate generalized Poisson data
no.gpois	dimension of the multivariate generalized Poisson distribution.
cmat.star	intermediate correlation matrix.
theta.vec	rate parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two, and each value has to be a positive number.
lambda.vec	dispersion parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two. All lambda values have to be < 1. For lambda < 0, lambda must be >= -theta/4.
details	index of whether to display the specified and empirical values of parameters. Default is set to be TRUE.

Value

data that follow multivariate generalized Poisson distribution.

References

Amatya, A. and Demirtas, H. (2015). Simultaneous generation of multivariate mixed data with Poisson and normal marginals. *Journal of Statistical Computation and Simulation*, **85(15)**, 3129-3139.

Amatya, A. and Demirtas, H. (2017). PoisNor: An R package for generation of multivariate data with Poisson and normal marginals. *Communications in Statistics - Simulation and Computation*, **46(3)**, 2241-2253.

Demirtas, H. (2017). On accurate and precise generation of generalized Poisson variates. *Communications in Statistics - Simulation and Computation*, **46(1)**, 489-499.

Yahav, I. and Shmueli, G.(2012). On generating multivariate Poisson data in management science applications. *Applied Stochastic Models in Business and Industry*, **28(1)**, 91-102.

Examples

```
sample.size = 10000; no.gpois = 3
lambda.vec = c(0.2, 0.2, 0.3); theta.vec = c(1, 3, 4)
M = c(0.352, 0.265, 0.342); N = diag(3); N[lower.tri(N)] = M
TV = N + t(N); diag(TV) = 1
cstar = CmatStarGpois(TV, theta.vec, lambda.vec)
data = GenMVGpois(sample.size, no.gpois, cstar, theta.vec, lambda.vec, details = FALSE)
apply(data, 2, mean) # empirical means
theta.vec / (1 - lambda.vec) # theoretical means
apply(data, 2, var) # empirical variances
theta.vec / (1 - lambda.vec)^3 # theoretical variances
cor(data) # empirical correlation matrix
TV # specified correlation matrix
```

GenUniGpois *Generates Univariate Generalized Poisson Variates*

Description

GenUniGpois generates univariate random variables from the generalized Poisson distribution using one of the five methods including Inversion, Branching, Normal-Approximation, Build-Up, Chop-Down.

Usage

```
GenUniGpois(theta, lambda, n, details = TRUE, method)
```

Arguments

theta	the rate parameter in the generalized Poisson distribution. It has to be a positive number.
lambda	the dispersion parameter in the generalized Poisson distribution. It has to be < 1. For lambda < 0, lambda must be greater than or equal to -theta/4.
n	number of data points that is to be generated.
details	index to indicate whether or not to print out the estimates of parameters. The default is set as TRUE.
method	index to specify one of the five methods: "Inversion", "Branching", "Normal-Approximation", "Build-Up" and "Chop-Down".

Details

All five methods come from Demirtas (2017). When lambda equals 0, it is the ordinary Poisson distribution, so there is no need to specify the method. "Branching" only works when lambda is positive. When theta is less than 10, a "Normal-Approximation" may not be reliable.

Value

a list that includes generated data, specified and empirical values of theta and lambda.

References

Demirtas, H. (2017). On accurate and precise generation of generalized Poisson variates. *Communications in Statistics - Simulation and Computation*, **46(1)**, 489-499.

Examples

```
GenUniGpois(2, 0.9, 100, method = "Branching")
GenUniGpois(5, -0.4, 100, method = "Inversion")
GenUniGpois(12, 0.5, 100, method = "Normal-Approximation")
data <- GenUniGpois(10, 0.4, 10, method = "Chop-Down", details = FALSE)
data <- GenUniGpois(3, 0.9, 10000, method = "Build-Up", details = FALSE)
```

`QuantileGpois` *Computes Quantiles*

Description

`QuantileGpois` computes the quantile for the generalized Poisson distribution for specified values of percentile, lambda and theta parameters.

Usage

```
QuantileGpois(p, theta, lambda, details = FALSE)
```

Arguments

`p`	percentile of the generalized Poisson distribution.
`theta`	the rate parameter in the generalized Poisson distribution. It has to be a positive number.
`lambda`	the dispersion parameter in the generalized Poisson distribution. It has to be < 1. For lambda < 0, lambda must be >= -theta/4.
`details`	show the detailed information of probability and cumulative probability. Default is set as FALSE.

Value

quantile of the specified distribution if the parameter *details* is set as FALSE. quantile and the detailed information of probability and cumulative probability if the parameter *details* is set as TRUE.

References

Demirtas, H. (2017). On accurate and precise generation of generalized Poisson variates. *Communications in Statistics - Simulation and Computation*, **46(1)**, 489-499.

Examples

```
QuantileGpois(0.98,1,-0.2,details = TRUE)
QuantileGpois(0.80,2,0.025,details = FALSE)
```

ValidCorrGpois *Validates Pairwise Correlations*

Description

`ValidCorrGpois` checks the validity of the values of pairwise correlations including positive definiteness, symmetry, and correctness of the dimensions.

Usage

```
ValidCorrGpois(corMat, theta.vec, lambda.vec)
```

Arguments

`corMat`	a positive definite target correlation matrix whose entries are within the valid correlation bounds.
`theta.vec`	rate parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two, and each value has to be a positive number.
`lambda.vec`	dispersion parameters in the generalized Poisson distribution. It is assumed that the length of the vector is at least two. All lambda values have to be < 1. For lambda < 0, lambda must be >= -theta/4.

Value

TRUE or FALSE.

References

Amatya, A. and Demirtas, H. (2017). PoisNor: An R package for generation of multivariate data with Poisson and normal marginals. *Communications in Statistics - Simulation and Computation*, **46(3)**, 2241-2253.

Demirtas, H. and Hedeker, D. (2011). A practical way for computing approximate lower and upper correlation bounds. *The American Statistician*, **65(2)**, 104-109.

Examples

```
ValidCorrGpois(matrix(c(1, 0.9, 0.9, 1), byrow = TRUE, nrow = 2), c(0.5, 0.5), c(0.1, 0.105))
ValidCorrGpois(matrix(c(1, 0.9, 0.9, 1), byrow = TRUE, nrow = 2), c(3, 2), c(-0.3, -0.2))
```

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