

# Package ‘RNGforGPD’

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**Type** Package

**Title** Random Number Generation for Generalized Poisson Distributions

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**Description** Generation of univariate and multivariate data that follow the generalized Poisson distribution. The details of the method are explained in Demirtas (2017) <DOI:10.1080/03610918.2014.968725>.

**License** GPL-2 | GPL-3

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**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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## R topics documented:

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RNGforGPD-package	<i>Generates Univariate and Multivariate Generalized Poisson Variables</i>
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## Description

This package is about generating univariate and multivariate data that follow the generalized Poisson distributions. There are seven functions in the package: `GenUniGpois` generates univariate the generalized Poisson variables; `GenMVGpois` generates the multivariate generalized Poisson variables; `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

Package:	RNGforGPD
Type:	Package
Version:	1.0
Date:	2018-04-09
License:	GPL-2   GPL-3

## Author(s)

Hesen Li, Ruizhe Chen, Hai Nguyen, Yu-Che Chung, Ran Gao, Hakan Demirtas

Maintainer: Ruizhe Chen <rchen18@uic.edu>

## References

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

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 matrix 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 $\geq -\theta/4$ .

### 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
```

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 ComputeCorrGpois

*Computes the Lower and Upper Correlation Bounds*


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### 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 $\geq -\theta/4$ .

### 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))
```

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CorrNNGpois	<i>Adjusts the Target Correlation</i>
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### 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 $\geq -\theta/4$ .
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)
```

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 GenMVGpois

*Generates Data from Multivariate Generalized Poisson Distribution*


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### 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

<code>sample.size</code>	desired sample size (number of rows) for the multivariate generalized Poisson data
<code>no.gpois</code>	dimension of the multivariate generalized Poisson distribution.
<code>cmat.star</code>	intermediate correlation matrix.
<code>theta.vec</code>	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.
<code>lambda.vec</code>	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 $\geq -\theta/4$ .
<code>details</code>	index of whether to displays the specified and empirical values of parameters. Default is set to be TRUE.

### Value

data that follow multivariate generalized Poisson distribution.

### References

- 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.
- 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.

**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)
```

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QuantileGpois

*Computes Quantiles*

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**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)
```

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ValidCorrGpois	<i>Validates Pairwise Correlation</i>
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**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 $\geq -\theta/4$ .

**Value**

TRUE or FALSE.

**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.

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.

**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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