Package 'pgnorm'

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Type Package

Title The p-Generalized Normal Distribution

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Description Evaluation of the pdf and the cdf of the univariate, noncentral, p-generalized normal distribution. Sampling from the univariate, noncentral, p-generalized normal distribution using either the p-generalized polar method, the p-generalized rejecting polar method, the Monty Python method, the Ziggurat method or the method of Nardon and Pianca. The package also includes routines for the simulation of the bivariate, p-generalized uniform distribution and the simulation of the corresponding angular distribution.

License GPL (>= 2)

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pgnorm-package *The p-Generalized Normal Distribution*

Description

The pgnorm-package includes routines to evaluate (cdf,pdf) and simulate the univariate p-generalized normal distribution with form parameter p, expectation $mean$ and standard deviation σ. The pdf of this distribution is given by

$$f(x, p, mean, \sigma) = (\sigma_p/\sigma)\, C_p\, \exp\left(-\left(\frac{\sigma_p}{\sigma}\right)^p \frac{|x - mean|^p}{p}\right),$$

where $C_p = p^{1-1/p}/2/\Gamma(1/p)$ and $\sigma_p^2 = p^{2/p}\,\Gamma(3/p)/\Gamma(1/p)$, which becomes

$$f(x, p, mean, \sigma) = C_p\, \exp\left(-\frac{|x|^p}{p}\right),$$

if $\sigma = \sigma_p$ and $mean = 0$. The random number generation can be realized with one of five different simulation methods including the p-generalized polar method, the p-generalized rejecting polar method, the Monty Python method, the Ziggurat method and the method of Nardon and Pianca. Additionally to the simulation of the p-generalized normal distribution, the related p-generalized uniform distribution on the p-generalized unit circle and the corresponding angular distribution can be simulated by using the functions "rpgunif" and "rpgangular", respectively.

Details

Package:	pgnorm
Type:	Package
Version:	2.0
Date:	2015-11-23
License:	GPL (>= 2)
LazyLoad:	yes

Author(s)

Steve Kalke <steve.kalke@googlemail.com>

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm(10,3)
```

`datasetpgnmp1` *Dataset 1 of the Monty Python method*

Description

The dataset contains tail algorithm constants for sampling from the tail of the p-generalized normal distribution in context of a simulation of the p-generalized normal distribution with the Monty Python method.

Usage

```
data(datasetpgnmp1)
```

Examples

```
data(datasetpgnmp1)
```

`datasetpgnmp2` *Dataset 2 of the Monty Python method*

Description

The dataset contains optimal rectangle widths in context of a simulation of the p-generalized normal distribution with the Monty Python method.

Usage

```
data(datasetpgnmp2)
```

Examples

```
data(datasetpgnmp2)
```

datasetpgnzig *Dataset of the Ziggurat method*

Description

The dataset contains tail algorithm constants for sampling from the tail of the p-generalized normal distribution in context of a simulation of the p-generalized normal distribution with the Ziggurat method.

Usage

```
data(datasetpgnzig)
```

Examples

```
data(datasetpgnzig)
```

dpgnorm *A function to evaluate the p-generalized normal density*

Description

The function evaluates the density $f(x, p, mean, sigma)$ of the univariate p-generalized normal distribution according to

$$f(x, p, mean, \sigma) = (\sigma_p/\sigma)\, C_p\, \exp\left(-\left(\frac{\sigma_p}{\sigma}\right)^p \frac{|x - mean|^p}{p}\right),$$

where $C_p = p^{1-1/p}/2/\Gamma(1/p)$ and $\sigma_p^2 = p^{2/p}\,\Gamma(3/p)/\Gamma(1/p)$.

Usage

```
dpgnorm(y, p, mean, sigma)
```

Arguments

y	The real argument of the function.
p	A positive number expressing the form parameter of the distribution. The default is 2.
mean	A real number expressing the expectation of the distribution. The default is 0.
sigma	A positive number expressing the standard deviation of the distribution. The default is σ_p.

Value

A real number.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-dpgnorm(0,3,1,2)
```

`ppgnorm` *A function to evaluate the p-generalized normal cdf*

Description

The function evaluates the cdf of the univariate p-generalized normal distribution according to the density

$$f(x, p, mean, \sigma) = (\sigma_p/\sigma)\, C_p\, \exp\left(-\left(\frac{\sigma_p}{\sigma}\right)^p \frac{|x - mean|^p}{p}\right),$$

where $C_p = p^{1-1/p}/2/\Gamma(1/p)$ and $\sigma_p^2 = p^{2/p}\,\Gamma(3/p)/\Gamma(1/p)$.

Usage

```
ppgnorm(y, p, mean, sigma)
```

Arguments

`y`	A real number, the argument of the function.
`p`	A positive number expressing the form parameter of the distribution. The default is 2.
`mean`	A real number expressing the expectation of the distribution. The default is 0.
`sigma`	A positive number expressing the standard deviation of the distribution. The default is σ_p.

Value

A real number.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-ppgnorm(2,p=3)
```

`rpgangular` *A random number generator for the angular distribution*

Description

The function simulates the univariate angular distribution corresponding to the p-generalized uniform distribution on the p-generalized unit circle.

Usage

```
rpgangular(n,p)
```

Arguments

`n`	The natural number of random variables to be simulated.
`p`	A positive number expressing the form parameter of the distribution. The default is 2.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgangular(10000,3)
```

rpgnorm *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate p-generalized normal distribution by using one of the following methods: the p-generalized polar method (pgenpolar), the p-generalized rejecting polar method (pgenpolarrej), the Monty Python method (montypython), the Ziggurat method (ziggurat) and the method of Nardon and Pianca (nardonpianca).

Usage

```
rpgnorm(n, p, mean, sigma, method)
```

Arguments

n	The natural number of random variables to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2. In case of the Monty Python method and the Ziggurat method, p can be chosen from $(1, \infty) \cup \{0.25, 0.45, 0.5, 0.6, 0.75\}$.
mean	A real number expressing the expectation of the distribution. The default is 0.
sigma	A positive number expressing the standard deviation of the distribution. The default is $\sigma_p = p^{1/p}\sqrt{\Gamma(3/p)/\Gamma(1/p)}$, the natural standard deviation of the p-generalized normal distribution.
method	A string expressing the method to be used for the simulation ("pgenpolar", "pgenpolarrej", "montypython", "ziggurat" or "nardonpianca"). The default is "nardonpianca".

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm(10000,3,method="pgenpolar")
```

rpgnorm_montypython *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate, central, p-generalized normal distribution by using the Monty Python method.

Usage

```
rpgnorm_montypython(n,p)
```

Arguments

n	The natural number of random variables to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2. In case of the Monty Python method, p can be chosen from $(1,\infty) \cup \{0.25, 0.45, 0.5, 0.6, 0.75\}$.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm_montypython(10000,3)
```

rpgnorm_nardonpianca *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate, central, p-generalized normal distribution by using the method of Nardon and Pianca.

Usage

```
rpgnorm_nardonpianca(n,p)
```

Arguments

n	The natural number of random variables to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm_nardonpianca(10000,3)
```

rpgnorm_pgenpolar *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate, central, p-generalized normal distribution by using the p-generalized polar method.

Usage

```
rpgnorm_pgenpolar(n,p)
```

Arguments

n	The natural number of random variables to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm_pgenpolar(10000,3)
```

---

rpgnorm_pgenpolarrej *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate, central, p-generalized normal distribution by using the p-generalized rejecting polar method.

Usage

```
rpgnorm_pgenpolarrej(n,p)
```

Arguments

n	The natural number of random variables to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm_pgenpolarrej(10000,3)
```

`rpgnorm_ziggurat` *A random number generator for the p-generalized normal distribution*

Description

The function simulates the univariate, central, p-generalized normal distribution by using the Ziggurat method.

Usage

```
rpgnorm_ziggurat(n,p,x)
```

Arguments

`n`	The natural number of random variables to be simulated.
`p`	A positive number expressing the form parameter of the distribution. The default is 2. In case of the Ziggurat method, p can be chosen from $(1,\infty) \cup \{0.25, 0.45, 0.5, 0.6, 0.75\}$.
`x`	(optional) A real vector containing the $2^8 - 1$ rightmost endpoints of the 2^8 ziggurat-rectangles.

Value

An n-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgnorm_ziggurat(10000,3)
```

rpgunif *A random number generator for the p-generalized uniform distribution*

Description

The function simulates the bivariate, p-generalized uniform distribution on the p-generalized unit circle.

Usage

```
rpgunif(n,p)
```

Arguments

n	The natural number of random vectors to be simulated.
p	A positive number expressing the form parameter of the distribution. The default is 2.

Value

A real $n \times 2$ matrix.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-rpgunif(10000,3)
```

zigsetup *A function for setting up the Ziggurat.*

Description

The function approximates the rightmost x-coordinates of the first n-1 rectangles defining the Ziggurat in case of the central, p-generalized normal distribution.

Usage

```
zigsetup(p, n, tol)
```

Arguments

p	A positive number expressing the form parameter of the distribution. The default is 2. In case of the Ziggurat method, p can be chosen from $(1, \infty) \cup \{0.25, 0.45, 0.5, 0.6, 0.75\}$.
n	The number of rectangles that build up the Ziggurat. The default is 2^8.
tol	A positive number expressing the approximation accuracy of the function. The default is 10^{-9}.

Value

An $(n-1)$-dimensional, real vector.

Author(s)

Steve Kalke

References

S. Kalke and W.-D. Richter (2013)."Simulation of the p-generalized Gaussian distribution." Journal of Statistical Computation and Simulation. Volume 83. Issue 4.

Examples

```
y<-zigsetup(3,20,10^(-6))
```

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