

Package ‘qGaussian’

July 22, 2025

Type Package

Title The q-Gaussian Distribution

Version 0.1.8

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Description Density, distribution function, quantile function and
random generation for the q-gaussian distribution with parameters mu and sig.

License GPL (>= 2)

Imports Rcpp (>= 0.12.10), stats, robustbase, zipfR

LinkingTo Rcpp

LazyData true

RoxygenNote 6.0.1

NeedsCompilation yes

Repository CRAN

Date/Publication 2018-07-12 18:50:06 UTC

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Chaotic	<i>Chaotic, a random number generator of q-Gaussian random variables.</i>
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Description

Given a random number generator of q-Gaussian random variables for a range of q values, $-8 < q < 3$, based on deterministic map dynamics. To yield a 'q' value, a characteristic entropic index of the q-gaussian distributions.

Usage

```
Chaotic(n,q,v0,z0)
```

Arguments

n	number of observations. If length(n) > 1, the length is taken to be the number required.
q	entropic index.
v0	a random seed.
z0	a random seed.

Value

a number $q < 3$, and the standard error.

Author(s)

Emerson Luis de Santa Helena , Wagner Santos de Lima

References

Umeno, K., Sato, A., IEEE Transactions on Information Theory (Volume:59,Issue:5,May 2013).Chaotic Method for Generating q-Gaussian Random Variables.

See Also

Distributions for other standard distributions, including dt and dcauchy. [Distributions](#)

Examples

```
t=Chaotic(100000,0,.1,.1)
hist(t,breaks=100)
```

cqgauss

*The q-gaussian Distribution***Description**

Density, distribution function, quantile function and random generation for the q-gaussian distribution with parameters mu and sig.

Usage

```
cqgauss(p, q = 0, mu = 0, sig = 1, lower.tail = TRUE)
```

Arguments

p	vector of probabilities.
q	entropic index.
mu	a value for q-mean.
sig	a value for q-variance.
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.

Details

If q, mu and sig values are not specified, they assume the default values of 0, 0 and 1, respectively. Defining $Z=(q-1)/(3-q)$, the q-gaussian distribution has density written as

$$p(x) = (\text{sig} * \text{Beta}(\alpha/2, 1/2))^{-1} * (1 + Z(x - \text{mu})^2 / \text{sig}^2)^{-(1 + 1/Z)/2}$$

where $\alpha = 1 - 1/Z$ when $q < 1$ and $1/Z$ when $1 < q < 3$.

Value

dqgauss gives the density, pqgauss gives the distribution function, cqgauss gives the quantile function, and rqgauss generates random deviates.

Author(s)

Emerson Luis de Santa Helena, Wagner Santos de Lima

References

Thistleton, W., Marsh, J. A., Nelson, K., Tsallis, C., (2007) IEEE Transactions on Information Theory, 53(12):4805

Tsallis, C., (2009) Introduction to Nonextensive Statistical Mechanics. Springer.

de Santa Helena, E. L., Nascimento, C. M., and Gerhardt, G. J., (2015) Alternative way to characterize a q-gaussian distribution by a robust heavy tail measurement. Physica A, (435):44-50.

Manuscript submitted for publication (2016) qGaussian: Tools to Explore Applications of Tsallis Statistics

See Also

Distributions for other standard distributions, including dt and dcauchy. [Distributions](#)

Examples

```

qv <- c(2.8,2.5,2,1.01,0,-5); nn <- 700
xrg <- sqrt((3-qv[6])/(1-qv[6]))
xr <- seq(-xrg,xrg,by=2*xrg/nn)
y0 <- dqgauss(xr,qv[6])
plot(xr,y0,ty='l',xlim=range(-4.5,4.5),ylab='p(x)',xlab='x')
for (i in 1:5){
  if (qv[i]< 1) xrg <- sqrt((3-qv[i])/(1-qv[i]))
  else xrg <- 4.5
  vby <- 2*xrg/nn
  xr <- seq(-xrg,xrg,by=2*xrg/nn)
  y0 <- dqgauss(xr,qv[i])
  points (xr,y0,ty='l',col=(i+1))
}
legend(2, 0.4, legend =c(expression(paste(q==5)),expression(paste(q==0)),
expression(paste(q==1.01)),expression(paste(q==2)),expression(paste(q==2.5)),
expression(paste(q==2.8))),col = c(1,6,5,4,3,2), lty = c(1,1,1,1,1,1))
#####

qv <- 0
rr <- rqgauss(2^16,qv)
nn <- 70
xrg <- sqrt((3-qv)/(1-qv))
vby <- 2*xrg/(nn)
xr <- seq(-xrg,xrg,by=vby)
hist (rr,breaks=xr,freq=FALSE,xlab="x",main='')
y <- dqgauss(xr)
lines(xr,y/sum(y*vby),cex=.5,col=2,lty=4)

```

dqgauss

The q-gaussian Distribution

Description

Density, distribution function, quantile function and random generation for the q-gaussian distribution with parameters mu and sig.

Usage

```

dqgauss(x, q = 0, mu = 0, sig = 1)

```

Arguments

x	vector of quantiles.
q	entropic index.
mu	a value for q-mean.
sig	a value for q-variance.

Details

If q, mu and sig values are not specified, they assume the default values of 0, 0 and 1, respectively. Defining $Z=(q-1)/(3-q)$, the q-gaussian distribution has density written as

$$p(x) = (\text{sig} * \text{Beta}(\alpha/2, 1/2))^{-1} * (1 + Z(x - \mu)^2 / \text{sig}^2)^{-(1 + 1/Z)/2}$$

where $\alpha = 1 - 1/Z$ when $q < 1$ and $1/Z$ when $1 < q < 3$.

Value

dqgauss gives the density, pqgauss gives the distribution function, cqgauss gives the quantile function, and rqgauss generates random deviates.

Author(s)

Emerson Luis de Santa Helena, Wagner Santos de Lima

References

Thistleton, W., Marsh, J. A., Nelson, K., Tsallis, C., (2007) IEEE Transactions on Information Theory, 53(12):4805

Tsallis, C., (2009) Introduction to Nonextensive Statistical Mechanics. Springer.

de Santa Helena, E. L., Nascimento, C. M., and Gerhardt, G. J., (2015) Alternative way to characterize a q-gaussian distribution by a robust heavy tail measurement. Physica A, (435):44-50.

Manuscript submitted for publication (2016) qGaussian: Tools to Explore Applications of Tsallis Statistics

See Also

Distributions for other standard distributions, including dt and dcauchy. [Distributions](#)

Examples

```
qv <- c(2.8, 2.5, 2, 1.01, 0, -5); nn <- 700
xrg <- sqrt((3-qv[6])/(1-qv[6]))
xr <- seq(-xrg, xrg, by=2*xrg/nn)
y0 <- dqgauss(xr, qv[6])
plot(xr, y0, ty='l', xlim=range(-4.5, 4.5), ylab='p(x)', xlab='x')
for (i in 1:5){
  if (qv[i] < 1) xrg <- sqrt((3-qv[i])/(1-qv[i]))
  else xrg <- 4.5
  vby <- 2*xrg/nn
```

```

xr <- seq(-xrg,xrg,by=2*xrg/nn)
y0 <- dqgauss(xr,qv[i])
points (xr,y0,ty='l',col=(i+1))
}
legend(2, 0.4, legend =c(expression(paste(q==5)),expression(paste(q==0)),
expression(paste(q==1.01)),expression(paste(q==2)),expression(paste(q==2.5)),
expression(paste(q==2.8))),col = c(1,6,5,4,3,2), lty = c(1,1,1,1,1,1))
#####

qv <- 0
rr <- rqgauss(2^16,qv)
nn <- 70
xrg <- sqrt((3-qv)/(1-qv))
vby <- 2*xrg/(nn)
xr <- seq(-xrg,xrg,by=vby)
hist (rr,breaks=xr,freq=FALSE,xlab="x",main='')
y <- dqgauss(xr)
lines(xr,y/sum(y*vby),cex=.5,col=2,lty=4)

```

pqgauss

The q-gaussian Distribution

Description

Density, distribution function, quantile function and random generation for the q-gaussian distribution with parameters mu and sig.

Usage

```
pqgauss(x, q = 0, mu = 0, sig = 1, lower.tail = TRUE)
```

Arguments

x	vector of quantiles.
q	entropic index.
mu	a value for q-mean.
sig	a value for q-variance.
lower.tail	logical; if TRUE (default), probabilities are $P[X \leq x]$ otherwise, $P[X > x]$.

Details

If q, mu and sig values are not specified, they assume the default values of 0, 0 and 1, respectively. Defining $Z=(q-1)/(3-q)$, the q-gaussian distribution has density written as

$$p(x) = (\text{sig} * \text{Beta}(\alpha/2, 1/2))^{\alpha-1} * (1 + Z(x-\mu)^2/\text{sig}^2)^{-(1+1/Z)/2}$$

where $\alpha = 1 - 1/Z$ when $q < 1$ and $1/Z$ when $1 < q < 3$.

Value

dqgauss gives the density, pqgauss gives the distribution function, cqgauss gives the quantile function, and rqgauss generates random deviates.

Author(s)

Emerson Luis de Santa Helena , Wagner Santos de Lima

References

Thistleton, W., Marsh, J. A., Nelson, K., Tsallis, C., (2007) IEEE Transactions on Information Theory, 53(12):4805

Tsallis, C., (2009) Introduction to Nonextensive Statistical Mechanics. Springer.

de Santa Helena, E. L., Nascimento, C. M., and Gerhardt, G. J., (2015) Alternative way to characterize a q-gaussian distribution by a robust heavy tail measurement. Physica A, (435):44-50.

Manuscript submitted for publication (2016) qGaussian: Tools to Explore Applications of Tsallis Statistics

See Also

Distributions for other standard distributions, including dt and dcauchy. [Distributions](#)

Examples

```

qv <- c(2.8,2.5,2,1.01,0,-5); nn <- 700
xrg <- sqrt((3-qv[6])/(1-qv[6]))
xr <- seq(-xrg,xrg,by=2*xrg/nn)
y0 <- dqgauss(xr,qv[6])
plot(xr,y0,ty='l',xlim=range(-4.5,4.5),ylab='p(x)',xlab='x')
for (i in 1:5){
  if (qv[i]< 1) xrg <- sqrt((3-qv[i])/(1-qv[i]))
  else xrg <- 4.5
  vby <- 2*xrg/nn
  xr <- seq(-xrg,xrg,by=2*xrg/nn)
  y0 <- dqgauss(xr,qv[i])
  points (xr,y0,ty='l',col=(i+1))
}
legend(2, 0.4, legend =c(expression(paste(q==5)),expression(paste(q==0)),
expression(paste(q==1.01)),expression(paste(q==2)),expression(paste(q==2.5)),
expression(paste(q==2.8))),col = c(1,6,5,4,3,2), lty = c(1,1,1,1,1,1))
#####

qv <- 0
rr <- rqgauss(2^16,qv)
nn <- 70
xrg <- sqrt((3-qv)/(1-qv))
vby <- 2*xrg/(nn)
xr <- seq(-xrg,xrg,by=vby)
hist (rr,breaks=xr,freq=FALSE,xlab="x",main='')
y <- dqgauss(xr)
lines(xr,y/sum(y*vby),cex=.5,col=2,lty=4)

```

`qbymc`*qbymc, a q value estimator founded upon medcouple.*

Description

Given a random data set, the 'qbymc' uses the medcouple, a robust measure of tail weights, to yield a 'q' value, a characteristic entropic index of the q-gaussian distributions.

Usage`qbymc(x)`**Arguments**

`x` numeric vector

Value

a number $q < 3$, and the standard error.

Author(s)

Emerson Luis de Santa Helena , Wagner Santos de Lima

References

de Santa Helena, E. L., Nascimento, C. M., and Gerhardt, G. J., (2015) Alternative way to characterize a q-gaussian distribution by a robust heavy tail measurement. Physica A, (435):44-50.

See Also

Robustbase for medcouple. [mc](#)

Examples

```
set.seed(0002)
rr <- rqgauss(1000, 1.333)
qbymc(rr)
```


rqgauss

*The q-gaussian Distribution***Description**

Density, distribution function, quantile function and random generation for the q-gaussian distribution with parameters mu and sig.

Usage

```
rqgauss(n, q = 0, mu = 0, sig = 1, meth = "Box-Muller")
```

Arguments

n	number of observations. If length(n) > 1, the length is taken to be the number required.
q	entropic index.
mu	a value for q-mean.
sig	a value for q-variance.
meth	method used at random generator

Details

If q, mu and sig values are not specified, they assume the default values of 0, 0 and 1, respectively. Defining $Z=(q-1)/(3-q)$, the q-gaussian distribution has density written as

$$p(x) = (\text{sig} * \text{Beta}(\alpha/2, 1/2))^{-1} * (1 + Z(x - \mu)^2 / \text{sig}^2)^{-(1 + 1/Z)/2}$$

where $\alpha = 1 - 1/Z$ when $q < 1$ and $1/Z$ when $1 < q < 3$.

For different methods use: meth = "Chaotic", meth = "Quantile" and meth = "Box-Muller"

Value

dqgauss gives the density, pqgauss gives the distribution function, cqgauss gives the quantile function, and rqgauss generates random deviates.

Author(s)

Emerson Luis de Santa Helena, Wagner Santos de Lima

References

Umeno, K., Sato, A., IEEE Transactions on Information Theory (Volume:59, Issue:5, May 2013). Chaotic Method for Generating q-Gaussian Random Variables.

Thistleton, W., Marsh, J. A., Nelson, K., Tsallis, C., (2007) IEEE Transactions on Information Theory, 53(12):4805

Tsallis, C., (2009) Introduction to Nonextensive Statistical Mechanics. Springer.

de Santa Helena, E. L., Nascimento, C. M., and Gerhardt, G. J., (2015) Alternative way to characterize a q-gaussian distribution by a robust heavy tail measurement. *Physica A*, (435):44-50.

de Lima, Wagner S., de Santa Helena, E. L., qGaussian: Tools to Explore Applications of Tsallis Statistics. arXiv:1703.06172

See Also

Distributions for other standard distributions, including dt and dcauchy. [Distributions](#)

Examples

```
qv <- c(2.8,2.5,2,1.01,0,-5); nn <- 700
xrg <- sqrt((3-qv[6])/(1-qv[6]))
xr <- seq(-xrg,xrg,by=2*xrg/nn)
y0 <- dqgauss(xr,qv[6])
plot(xr,y0,ty='l',xlim=range(-4.5,4.5),ylab='p(x)',xlab='x')
for (i in 1:5){
  if (qv[i]< 1) xrg <- sqrt((3-qv[i])/(1-qv[i]))
  else xrg <- 4.5
  vby <- 2*xrg/nn
  xr <- seq(-xrg,xrg,by=2*xrg/nn)
  y0 <- dqgauss(xr,qv[i])
  points (xr,y0,ty='l',col=(i+1))
}
legend(2, 0.4, legend =c(expression(paste(q==5)),expression(paste(q=0)),
expression(paste(q==1.01)),expression(paste(q==2)),expression(paste(q==2.5)),
expression(paste(q==2.8))),col = c(1,6,5,4,3,2), lty = c(1,1,1,1,1,1))
#####

qv <- 0
rr <- rqgauss(2^16,qv)
nn <- 70
xrg <- sqrt((3-qv)/(1-qv))
vby <- 2*xrg/(nn)
xr <- seq(-xrg,xrg,by=vby)
hist (rr,breaks=xr,freq=FALSE,xlab="x",main='')
y <- dqgauss(xr)
lines(xr,y/sum(y*vby),cex=.5,col=2,lty=4)
```

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