Package ‘qGaussian’

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Type Package

Title The q-Gaussian Distribution

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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

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R topics documented:

`Chaotic`	*Chaotic, a random number generator of q-Gaussian random variables.*

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 <= 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 wrinten as

p(x) = (sig*Beta(alpha/2,1/2))^-1*(1+Z(x-mu)^2/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 charecterize 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 wrinten as

p(x) = (sig*Beta(alpha/2,1/2))^-1*(1+Z(x-mu)^2/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 charecterize 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 <= 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 wrinten as

p(x) = (sig*Beta(alpha/2,1/2))^-1*(1+Z(x-mu)^2/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 charecterize 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 charecterize 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 wrinten as

p(x) = (sig*Beta(alpha/2,1/2))^-1*(1+Z(x-mu)^2/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)
```

Index