

# Package ‘logitnorm’

March 14, 2017

**Title** Functions for the Logitnormal Distribution

**Version** 0.8.34

**Date** 2017-03-14

**Author** Thomas Wutzler

**Maintainer** Thomas Wutzler <twutz@bgc-jena.mpg.de>

**Description** Density, distribution, quantile and random generation function for the logitnormal distribution. Estimation of the mode and the first two moments. Estimation of distribution parameters.

**Depends**

**Suggests** RUnit, knitr, ggplot2, reshape2

**VignetteBuilder** knitr

**License** GPL-2

**LazyData** true

**Repository** CRAN

**Repository/R-Forge/Project** logitnorm

**Repository/R-Forge/Revision** 41

**Repository/R-Forge/DateTimeStamp** 2017-03-14 11:58:07

**Date/Publication** 2017-03-14 14:31:29

**NeedsCompilation** no

## R topics documented:

logitnorm-package . . . . .	2
dlogitnorm . . . . .	3
invlogit . . . . .	4
logit . . . . .	4
modeLogitnorm . . . . .	5
momentsLogitnorm . . . . .	6
plogitnorm . . . . .	7
qlogitnorm . . . . .	7
rlogitnorm . . . . .	8

twCoefLogitnorm . . . . .	8
twCoefLogitnormCi . . . . .	10
twCoefLogitnormE . . . . .	11
twCoefLogitnormMLE . . . . .	13
twCoefLogitnormMLEFlat . . . . .	14
twCoefLogitnormN . . . . .	15
twSigmaLogitnorm . . . . .	16
<b>Index</b>	<b>18</b>

---

logitnorm-package	<i>Utilities for the logitnormal distribution in R</i>
-------------------	--

---

## Description

Utilities for the logitnormal distribution in R

- Density, distribution, quantile and random generation function.
- Estimation of the mode and the first two moments.
- Estimation of distribution parameters from observations.

## Details

The logitnormal distribution is useful as a prior density for variables that are bounded between 0 and 1, such as proportions. Fig. 1 displays its density for various combinations of parameters  $\mu$  and  $\sigma$ .

The package provides the main distribution functions:

- density `dlogitnorm`,
- distribution `plogitnorm`,
- quantile `qlogitnorm`, and
- random generation function `rlogitnorm`.

Transformation functions

- $(0,1) \rightarrow (-\infty, \infty)$ : `logit`
- $(-\infty, \infty) \rightarrow (0,1)$ : `invlogit`

Moments and mode

- Expected value and variance: `momentsLogitnorm`
- Mode: `modeLogitnorm`

Estimating parameters

- from mode and upper quantile: `twCoefLogitnormMLE`
- from mode and constraint to be unimodal and maximally flat: `twCoefLogitnormMLEFlat`
- from median and upper quantile: `twCoefLogitnorm`

- from expected value, i.e. mean and upper quantile: [twCoefLogitnormE](#)
- from a confidence interval which is symmetric at normal scale: [twCoefLogitnormCi](#)
- from prescribed quantiles: [twCoefLogitnormN](#)

**Author(s)**

Thomas Wutzler

**References**

Frederic, P. & Lad, F. (2008) Two Moments of the Logitnormal Distribution. Communications in Statistics-Simulation and Computation, 37, 1263-1269

---

dlogitnorm

*dlogitnorm*


---

**Description**

Density function of logitnormal distribution

**Usage**

```
dlogitnorm(q, mu = 0, sigma = 1, log = FALSE, ...)
```

**Arguments**

q	quantiles
mu	distribution parameters
sigma	
log	if TRUE, the log-density is returned
...	further arguments passed to <a href="#">dnorm</a> : mean, and sd for mu and sigma respectively.

**Details**

**Logitnorm distribution** • density function: `dlogitnorm`

- distribution function: [plogitnorm](#)
- quantile function: [qlogitnorm](#)
- random generation function: [rlogitnorm](#)

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

*invlogit**invlogit*

---

**Description**

Transforming (-Inf,Inf) to original scale (0,1)

**Usage**

```
invlogit(q, ...)
```

**Arguments**

q

...

**Details**

function  $f(z) = \frac{e^z}{e^z+1} = \frac{1}{1+e^{-z}}$

**Author(s)**

Thomas Wutzler

**See Also**

[logit](#)

[logitnorm](#)

---

*logit**logit*

---

**Description**

Transforming (0,1) to normal scale (-Inf Inf)

**Usage**

```
logit(p, ...)
```

**Arguments**

p

...

**Details**

function  $\text{logit}(p) = \log\left(\frac{p}{1-p}\right) = \log(p) - \log(1-p)$

**Author(s)**

Thomas Wutzler

**See Also**

[invlogit](#)

[logitnorm](#)

---

modeLogitnorm

*modeLogitnorm*

---

**Description**

Mode of the logitnormal distribution by numerical optimization

**Usage**

```
modeLogitnorm(mu, sigma, tol = invlogit(mu)/1000)
```

**Arguments**

mu	parameter mu
sigma	parameter sigma
tol	precisions of the estimate

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

---

momentsLogitnorm	<i>momentsLogitnorm</i>
------------------	-------------------------

---

## Description

First two moments of the logitnormal distribution by numerical integration

## Usage

```
momentsLogitnorm(mu, sigma, abs.tol = 0, ...)
```

## Arguments

mu	parameter mu
sigma	parameter sigma
abs.tol	changing default to <a href="#">integrate</a>
...	further parameters to the <a href="#">integrate</a> function

## Value

named numeric vector with components

- mean: expected value, i.e. first moment
- var: variance, i.e. second moment

## Author(s)

Thomas Wutzler

## Examples

```
(res <- momentsLogitnorm(4,1))
```

```
(res <- momentsLogitnorm(5,0.1))
```

---

plogitnorm

*plogitnorm*

---

### Description

Distribution function for logitnormal distribution

### Usage

```
plogitnorm(q, mu = 0, sigma = 1, ...)
```

### Arguments

q  
mu                    distribution parameters  
sigma  
...

### Author(s)

Thomas Wutzler

### See Also

[logitnorm](#)

---

qlogitnorm

*qlogitnorm*

---

### Description

Quantiles of logitnormal distribution.

### Usage

```
qlogitnorm(p, mu = 0, sigma = 1, ...)
```

### Arguments

p  
mu                    distribution parameters  
sigma  
...

Author(s)

Thomas Wutzler

See Also

[logitnorm](#)

---

rlogitnorm	<i>rlogitnorm</i>
------------	-------------------

---

Description

Random number generation for logitnormal distribution

Usage

```
rlogitnorm(mu = 0, sigma = 1, ...)
```

Arguments

mu	distribution parameters
sigma	
...	arguments to <a href="#">rnorm</a>

Author(s)

Thomas Wutzler

See Also

[logitnorm](#)

---

twCoefLogitnorm	<i>twCoefLogitnorm</i>
-----------------	------------------------

---

Description

Estimating coefficients of logitnormal distribution from median and upper quantile



**Usage**

```
twCoefLogitnorm(median, quant, perc = 0.975, method = "BFGS",  
  
  theta0 = c(mu = 0, sigma = 1), returnDetails = FALSE,  
  
  ...)
```

**Arguments**

median	numeric vector: the median of the density function
quant	numeric vector: the upper quantile value
perc	numeric vector: the probability for which the quantile was specified
method	method of optimization (see <a href="#">optim</a> )
theta0	starting parameters
returnDetails	if TRUE, the full output of optim is attached as attributes resOptim
...	

**Value**

numeric matrix with columns `c("mu", "sigma")`  
rows correspond to rows in median, quant, and perc

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

**Examples**

```
# estimate the parameters, with median at 0.7 and upper quantile at 0.9  
  
(theta <- twCoefLogitnorm(0.7,0.9))  
  
x <- seq(0,1,length.out=41)[-c(1,41)] # plotting grid
```

```

px <- plogitnorm(x,mu=theta[1],sigma=theta[2]) #percentiles function

plot(px~x); abline(v=c(0.7,0.9),col="gray"); abline(h=c(0.5,0.975),col="gray")

dx <- dlogitnorm(x,mu=theta[1],sigma=theta[2]) #density function

plot(dx~x); abline(v=c(0.7,0.9),col="gray")

# vectorized

(theta <- twCoefLogitnorm(seq(0.4,0.8,by=0.1),0.9))

```

---

twCoefLogitnormCi

*twCoefLogitnormCi*


---

### Description

Calculates mu and sigma of the logitnormal distribution from lower and upper quantile, i.e. confidence interval.

### Usage

```

twCoefLogitnormCi(lower, upper, perc = 0.975, sigmaFac = qnorm(perc),

isTransScale = FALSE)

```

### Arguments

lower	value at the lower quantile, i.e. practical minimum
upper	value at the upper quantile, i.e. practical maximum
perc	numeric vector: the probability for which the quantile was specified
sigmaFac	sigmaFac=2 is 95% sigmaFac=2.6 is 99% interval
isTransScale	if true lower and upper are already on logit scale

**Value**

named numeric vector: mu and sigma parameter of the logitnormal distribution.

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

**Examples**

```
mu=2

sd=c(1,0.8)

p=0.99

lower <- l <- qlogitnorm(1-p, mu, sd ) # p-confidence interval

upper <- u <- qlogitnorm(p, mu, sd ) # p-confidence interval

cf <- twCoefLogitnormCi(lower,upper)

all.equal( cf[, "mu"] , c(mu,mu) )

all.equal( cf[, "sigma"] , sd )
```

---

twCoefLogitnormE

*twCoefLogitnormE*


---

**Description**

Estimating coefficients of logitnormal distribution from expected value, i.e. mean, and upper quantile.

**Usage**

```
twCoefLogitnormE(mean, quant, perc = c(0.975), method = "BFGS",

  theta0 = c(mu = 0, sigma = 1), returnDetails = FALSE,

  ...)
```

**Arguments**

mean	the expected value of the density function
quant	the quantile values
perc	the probabilities for which the quantiles were specified
method	method of optimization (see <a href="#">optim</a> )
theta0	starting parameters
returnDetails	if TRUE, the full output of optim is returned with attribut resOptim
...	

**Value**

named numeric matrix with estimated parameters of the logitnormal distribution.  
 colnames: c("mu", "sigma")

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

**Examples**

```
# estimate the parameters

(thetaE <- twCoefLogitnormE(0.7, 0.9))

x <- seq(0, 1, length.out = 41)[-c(1, 41)] # plotting grid
```

```

px <- plogitnorm(x,mu=thetaE[1],sigma=thetaE[2]) #percentiles function

plot(px~x); abline(v=c(0.7,0.9),col="gray"); abline(h=c(0.5,0.975),col="gray")

dx <- dlogitnorm(x,mu=thetaE[1],sigma=thetaE[2]) #density function

plot(dx~x); abline(v=c(0.7,0.9),col="gray")

z <- rlogitnorm(1e5, mu=thetaE[1],sigma=thetaE[2])

mean(z) # about 0.7

# vectorized

(theta <- twCoefLogitnormE(mean=seq(0.4,0.8,by=0.1),quant=0.9))

```

---

twCoefLogitnormMLE	<i>twCoefLogitnormMLE</i>
--------------------	---------------------------

---

## Description

Estimating coefficients of logitnormal distribution from mode and upper quantile

## Usage

```
twCoefLogitnormMLE(mle, quant, perc = 0.999)
```

## Arguments

mle	numeric vector: the mode of the density function
quant	numeric vector: the upper quantile value
perc	numeric vector: the probability for which the quantile was specified

**Value**

numeric matrix with columns `c("mu", "sigma")` rows correspond to rows in `mle`, `quant`, and `perc`

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

**Examples**

```
# estimate the parameters, with mode 0.7 and upper quantile 0.9
(theta <- twCoefLogitnormMLE(0.7,0.9))

x <- seq(0,1,length.out=41)[-c(1,41)] # plotting grid
px <- plogitnorm(x,mu=theta[1],sigma=theta[2]) #percentiles function
plot(px~x); abline(v=c(0.7,0.9),col="gray"); abline(h=c(0.999),col="gray")
dx <- dlogitnorm(x,mu=theta[1],sigma=theta[2]) #density function
plot(dx~x); abline(v=c(0.7,0.9),col="gray")

# vectorized
(theta <- twCoefLogitnormMLE(mle=seq(0.4,0.8,by=0.1),quant=0.9))

# flat
(theta <- twCoefLogitnormMLEFlat(0.7))
```

---

twCoefLogitnormMLEFlat

*twCoefLogitnormMLEFlat*

---

**Description**

Estimating coefficients of a maximally flat unimodal logitnormal distribution from mode

**Usage**

```
twCoefLogitnormMLEFlat(mle)
```

**Arguments**

`mle`                      numeric vector: the mode of the density function

**Details**

When increasing the sigma parameter, the distribution becomes eventually bi-model, i.e. has two maxima. This function estimates parameters for given mode, so that the distribution assigns high density to a maximum range, i.e. is maximally flat, but still is unimodal.

**Author(s)**

Thomas Wutzler

twCoefLogitnormN

*twCoefLogitnormN***Description**

Estimating coefficients of logitnormal distribution from a vector of quantiles and perentiles (non-vectorized).

**Usage**

```
twCoefLogitnormN(quant, perc = c(0.5, 0.975), method = "BFGS",

  theta0 = c(mu = 0, sigma = 1), returnDetails = FALSE,

  ...)
```

**Arguments**

quant	the quantile values
perc	the probabilites for which the quantiles were specified
method	method of optimization (see <a href="#">optim</a> )
theta0	starting parameters
returnDetails	if TRUE, the full output of optim is returned instead of only entry par
...	further parameters passed to optim, e.g. control=list(maxit=1000)

**Value**

named numeric vector with estimated parameters of the logitnormal distrubtion.  
 names: c("mu", "sigma")

**Author(s)**

Thomas Wutzler

**See Also**[logitnorm](#)

**Examples**

```

# experiment of re-estimation the parameters from generated observations

thetaTrue <- c(mu=0.8, sigma=0.7)

obsTrue <- rlogitnorm(thetaTrue["mu"],thetaTrue["sigma"], n=500)

obs <- obsTrue + rnorm(100, sd=0.05)      # some observation uncertainty

plot(density(obsTrue),col="blue"); lines(density(obs))

# re-estimate parameters based on the quantiles of the observations

(theta <- twCoefLogitnorm( median(obs), quantile(obs,probs=0.9), perc = 0.9))

# add line of estimated distribution

x <- seq(0,1,length.out=41)[-c(1,41)] # plotting grid

dx <- dlogitnorm(x,mu=theta[1],sigma=theta[2])

lines( dx ~ x, col="orange")

```

---

twSigmaLogitnorm

*twSigmaLogitnorm*


---

**Description**

Estimating coefficients of logitnormal distribution from mode and given mu



**Usage**

```
twSigmaLogitnorm(mle, mu = 0)
```

**Arguments**

mle	numeric vector: the mode of the density function
mu	for mu=0 the distribution will be the flattest case (maybe bimodal)

**Details**

For a mostly flat unimodal distribution use [twCoefLogitnormMLE\(mle,0\)](#)

**Value**

numeric matrix with columns c("mu", "sigma") rows correspond to rows in mle and mu

**Author(s)**

Thomas Wutzler

**See Also**

[logitnorm](#)

**Examples**

```
mle <- 0.8
(theta <- twSigmaLogitnorm(mle))
#
x <- seq(0,1,length.out=41)[-c(1,41)] # plotting grid
px <- plogitnorm(x,mu=theta[1],sigma=theta[2]) #percentiles function
plot(px~x); abline(v=c(mle),col="gray")
dx <- dlogitnorm(x,mu=theta[1],sigma=theta[2]) #density function
plot(dx~x); abline(v=c(mle),col="gray")
# vectorized
(theta <- twSigmaLogitnorm(mle=seq(0.401,0.8,by=0.1)))
```

# Index

## \*Topic **package**

logitnorm-package, 2

dlogitnorm, 2, 3

dnorm, 3

integrate, 6

invlogit, 2, 4, 5

logit, 2, 4, 4

logitnorm, 3–5, 7–9, 11, 12, 14, 15, 17

logitnorm(logitnorm-package), 2

logitnorm-package, 2

modeLogitnorm, 2, 5

momentsLogitnorm, 2, 6

optim, 9, 12, 15

plogitnorm, 2, 3, 7

qlogitnorm, 2, 3, 7

rlogitnorm, 2, 3, 8

rnorm, 8

twCoefLogitnorm, 2, 8

twCoefLogitnormCi, 3, 10

twCoefLogitnormE, 3, 11

twCoefLogitnormMLE, 2, 13, 17

twCoefLogitnormMLEFlat, 2, 14

twCoefLogitnormN, 3, 15

twSigmaLogitnorm, 16