# Package: logitnorm (via r-universe)

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**Title** Functions for the Logitnormal Distribution

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**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.

**Suggests** knitr, markdown, ggplot2, testthat (>= 3.0.0)

**VignetteBuilder** knitr

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`logitnorm-package` *Utilities for the logitnormal distribution in R*

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## 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 package provides the main distribution functions:

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

Transformation functions

- (0,1) -> (-Inf,Inf): `logit`
- (-Inf,Inf) -> (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`

Have a look at the package vignettes.

## 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

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`dlogitnorm` *dlogitnorm*

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## Description

Density function of logitnormal distribution

## Usage

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

## Arguments

| | |
|---|---|
| `x` | vector of quantiles |
| `mu` | scale distribution parameter |
| `sigma` | location distribution parameter |
| `log` | if TRUE, the log-density is returned |
| `...` | further arguments passed to `dnorm`: `mean`, and `sd` for mu and sigma respectively. |

## Details

**Logitnorm distribution**

- density function: dlogitnorm
- distribution function: `plogitnorm`
- quantile function: `qlogitnorm`
- random generation function: `rlogitnorm`

The function is only defined in interval (0,1), but the density returns 0 outside the support region.

## Author(s)

Thomas Wutzler

## See Also

`logitnorm`

## invlogit *invlogit*

### Description

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

### Usage

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

### Arguments

| | |
|---|---|
| q | quantile |
| ... | further arguments to plogis |

### 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 | percentile |
| ... | further arguments to qlogis |

## Details

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

## Author(s)

Thomas Wutzler

## See Also

invlogit

logitnorm

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`modeLogitnorm` *modeLogitnorm*

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## 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 *momentsLogitnorm*

## 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 integrate |
| ... | further parameters to the integrate 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 | vector of quantiles |
| mu | location distribution parameter |
| sigma | scale distribution parameter |
| ... | further arguments to pnorm |

### Author(s)

Thomas Wutzler

### See Also

logitnorm

## qlogitnorm *qlogitnorm*

### Description

Quantiles of logitnormal distribution.

### Usage

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

### Arguments

| | |
|---|---|
| p | vector of probabilities |
| mu | location distribution parameter |
| sigma | scale distribution parameter |
| ... | further arguments to plogis |

## Author(s)

Thomas Wutzler

## See Also

logitnorm

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`rlogitnorm` *rlogitnorm*

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## Description

Random number generation for logitnormal distribution

## Usage

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

## Arguments

| | |
|---|---|
| `n` | number of observations |
| `mu` | distribution parameter |
| `sigma` | distribution parameter |
| `...` | arguments to `rnorm` |

## Author(s)

Thomas Wutzler

## See Also

logitnorm

twCoefLogitnorm *twCoefLogitnorm*

## Description

Estimating coefficients of logitnormal distribution from median and upper quantile

## Usage

```
twCoefLogitnorm(median, quant, perc = 0.975)
```

## 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 |

## 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
med = 0.7; upper = 0.9
med = 0.2; upper = 0.4
(theta <- twCoefLogitnorm(med,upper))

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(med,upper),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(med,upper),col = "gray")

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

.tmp.f <- function(){
  # xr = rlogitnorm(1e5, mu = theta["mu"], sigma = theta["sigma"])
```

```
  # median(xr)
  invlogit(theta["mu"])
  qlogitnorm(0.975, mu = theta["mu"], sigma = theta["sigma"])
}
```

---

`twCoefLogitnormCi` *twCoefLogitnormCi*

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## 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, perc = p)
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 optim) |
| theta0 | starting parameters |
| returnDetails | if TRUE, the full output of optim is returned with attribute resOptim |
| ... | further arguments to optim |

## 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` *twCoefLogitnormMLE*

---

## 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
mode = 0.7; upper = 0.9
(theta <- twCoefLogitnormMLE(mode,upper))
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(mode,upper),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(mode,upper),col = "gray")
# vectorized
(theta <- twCoefLogitnormMLE(mle = seq(0.4,0.8,by = 0.1),quant = upper))
# flat
(theta <- twCoefLogitnormMLEFlat(mode))
```

## twCoefLogitnormMLEFlat *twCoefLogitnormMLEFlat*

### Description

Estimating coefficients of a maximally flat unimodal logitnormal distribution given the mode

### Usage

```
twCoefLogitnormMLEFlat(mle)
```

### Arguments

| | |
|---|---|
| mle | numeric vector: the mode of the density function |

### Author(s)

Thomas Wutzler

## twCoefLogitnormN *twCoefLogitnormN*

### Description

Estimating coefficients from a vector of quantiles and percentiles (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 probabilities for which the quantiles were specified |
| method | method of optimization (see optim) |
| 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 distribution. 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)))
```

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