

Package ‘mlelod’

July 23, 2025

Type Package

Title MLE for Normally Distributed Data Censored by Limit of Detection

Version 1.0.0.1

Date 2024-05-14

Description Values below the limit of detection (LOD) are a problem in several fields of science, and there are numerous approaches for replacing the missing data. We present a new mathematical solution for maximum likelihood estimation that allows us to estimate the true values of the mean and standard deviation for normal distributions and is significantly faster than previous implementations. The article with the details was submitted to JSS and can be currently seen on https://www2.arnes.si/~tverbo/LOD/Verbovsek_Sega_2_Manuscript.pdf.

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NeedsCompilation no

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mlelod-package	<i>MLE for Normally Distributed Data Censored by Limit of Detection</i>
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Description

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Details

The DESCRIPTION file:

```
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Authors@R:    person("Gregor", "Sega", , "gregor.sega@fmf.uni-lj.si", role = c("aut", "cre"))
Author:        Gregor Sega [aut, cre]
Maintainer:    Gregor Sega <gregor.sega@fmf.uni-lj.si>
License:       GPL-2
```

Index of help topics:

```
mlelod          Estimates the parameters of the normal
                 distribution.
mlelod-package  MLE for Normally Distributed Data Censored by
                 Limit of Detection
```

Values below the limit of detection (LOD) are a problem in several fields of science, and there are numerous approaches for replacing the missing data. This package uses a new mathematical solution for maximum likelihood estimation that allows us to estimate the true values of the mean and standard deviation for normal distributions and is significantly faster than previous implementations. The core function is the function `mlelod` with three parameters: the size of the sample, the values of the sample and the value of limit of detection. The function returns two estimates: for μ (expected value) and σ (standard deviation).

Author(s)

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```

References

The article with the derived method is submitted to Journal of Statistical Software

mlelod	<i>Estimates the parameters of the normal distribution.</i>
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Description

The function returns the two estimates for the parameters of the normal distribution.

Usage

```
mlelod(n, censoreddata, lod)
```

Arguments

n	n is the size of the sample
censoreddata	censoreddata is the vector containing the values of the sample which are greater than lod
lod	lod is the value of level of detection.

Value

muEst	Description of 'comp1'
sigmaEst	Description of 'comp2'

Author(s)

Gregor Segal

References

The article with the derived method is submitted to Journal of Statistical Software

Examples

```
## The function is currently defined as
mlelod <- function (n, censoreddata, lod)
{
  k <- length(censoreddata)
  s <- sum(censoreddata)
  s2 <- sum(censoreddata^2)
  g <- function(x, n, k, s, s2, lod) {
    a <- (k * (lod^2 - x^2) + s2 - 2 * lod * s) / (x * (k *
      lod - s))
    b <- s - k * (k * x^2 + lod * s - s2) / (k * lod - s) -
      x * (n - k) * dnorm(a, 0, 1) / pnorm(a, 0, 1)
    return(b)
  }
  h <- function(x) {
    return(g(x, n, k, s, s2, lod))
  }
}
```

```
}
lsi <- sqrt(s2/k - (s/k)^2)
sigmaEst <- uniroot(h, lower = lsi/4, upper = 4 * lsi, tol = 1e-06)$root
muEst <- (k * sigmaEst^2 + lod * s - s2)/(k * lod - s)
return(list(muEst = muEst, sigmaEst = sigmaEst))
}
##define the parameters of the normal distribution
mu <- 5
sigma <- 4
##define the size of the sample and the value of lod
n <- 100
lod <- 2
##generate normally distributed data and extract the observable values (the ones exceeding lod)
data <- rnorm(n, mu, sigma)
data2 <- Filter(function(x) x>lod,data)
##run the function to obtain the estimates
mlelod(n, data2, lod)
```

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