Package ‘fuel’

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Title  Framework for Unified Estimation in Lognormal Models
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Description  Lognormal models have broad applications in various research areas such as economics, actuarial science, biology, environmental science and psychology. The estimation problem in lognormal models has been extensively studied. This R package 'fuel' implements thirty-nine existing and newly proposed estimators. See Zhang, F., and Gou, J. (2020), A unified framework for estimation in lognormal models, Technical report.
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Description

Lognormal models are also widely applied in various branches of natural, social and applied sciences. Given a pair of known constants in the parametric function for the statistics in the lognormal distribution, sample size, degree of freedom of the variance estimation of the log-transformed data, standardized variance of the sampling distribution of the log-transformed data, mean of the log-transformed data and standard deviation of the log-transformed data, this function returns an estimation for the lognormal distribution, including a total of thirty-nine different estimation methods, under a newly proposed unified framework in Zhang and Gou (2020).

Usage

```
lognormalest(n, m = n - 1, d = 1/n, mean.rn, sd.rn, a, b, estimator)
```

Arguments

- `n` sample size.
- `m` degree of freedom of the variance estimation of the log-transformed data.
- `d` standardized variance of the sampling distribution of the log-transformed data.
- `mean.rn` mean of the log-transformed data.
- `sd.rn` standard deviation of the log-transformed data.
- `a` the first known constants in the parametric function for the statistics.
- `b` the second known constants in the parametric function for the statistics.
- `estimator` a total of thirty-eight different estimation methods. See more descriptions in Section Details.

Details

Consider a parametric function in the original scale we are interested in estimating $\theta(a, b) = \exp(a\mu + b\sigma^2/2)$, where constants $a$ and $b$ are known. Specifically, $\theta(1, 1)$ is the mean of the lognormal distribution, $\theta(2, 4)$ is the second moment, $\theta(2, 4) - \theta(2, 2)$ is the variance, and $(\theta(0, 2) - 1)^{1/2}$ is the coefficient of variation.

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12. \( ev \): El-Shaarawi and Viveros’ estimator (El-Shaarawi and Viveros, 1997)
13. \( zh \): Zhou’s estimator (Zhou, 1998)
14. \( sz-mm \): Shen and Zhu’s MM estimator (Shen and Zhu, 2008)
15. \( sz-mb \): Shen and Zhu’s MB estimator (Shen and Zhu, 2008)
16. \( 1-ub \): Longford’s UB estimator (Longford, 2009)
17. \( 1-ms \): Longford’s MS estimator (Longford, 2009)
18. \( ft \): Fabrizi and Trivisano’s Simplified Bayes estimator (Fabrizi and Trivisano, 2012)
19. \( ft-s \): Fabrizi and Trivisano’s Simplified Bayes estimator (Fabrizi and Trivisano, 2012)
20. \( ft-b \): Fabrizi and Trivisano’s Bayes estimator (Fabrizi and Trivisano, 2012)
21. \( gt-f \): Gou and Tamhane’s estimator using Finney’s function (Gou and Tamhane, 2017)
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23. \( gt-r \): Gou and Tamhane’s estimator using Rukhin’s function (Gou and Tamhane, 2017)
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42. \( zg-19 \): Zhang and Gou’s nineteenth estimator (Zhang and Gou, 2020)
Value

estimation using a specific estimating method.

Author(s)

Jiangtao Gou
Fengqing (Zoe) Zhang

References


Examples

```r
library(fuel)
# Unbiased Estimation (Finney, 1941)
fuel::lognormalest(n=10, m=9, d=1/10, mean.rn=1, sd.rn=1, a=1, b=1, estimator='unbiased')
# Longford's estimator, minimize the mean squared error (Longford, 2009)
fuel::lognormalest(n=10, m=9, d=1/10, mean.rn=1, sd.rn=1, a=1, b=1, estimator='l-ms')
# Gou and Tamhane's estimator, Rukhin type (Gou and Tamhane, 2017)
fuel::lognormalest(n=10, m=9, d=1/10, mean.rn=1, sd.rn=1, a=1, b=1, estimator='gt-r')
# Zhang and Gou's No.4 estimator (Zhang and Gou, 2020)
fuel::lognormalest(n=10, m=9, d=1/10, mean.rn=1, sd.rn=1, a=1, b=1, estimator='zg-4')
```
Description

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Usage

```r
lognormalmean(
  data,
  estimator,
  base = exp(1),
  n = length(data),
  m = n - 1,
  d = 1/n
)
```

Arguments

data: original data vector
estimator: a total of thirty-eight different estimation methods. See more descriptions in Section Details.
base: the base with respect to which logarithms are computed. Defaults to e.
n: sample size.
m: degree of freedom of the variance estimation of the log-transformed data.
d: standardized variance of the sampling distribution of the log-transformed data.

Details

Consider a parametric function in the original scale we are interested in estimating \( \theta(a, b) = e^{a \mu + b \sigma^2 / 2} \), where constants \( a \) and \( b \) are known. Specifically, \( \theta(1, 1) \) is the mean of the lognormal distribution, \( \theta(2, 4) \) is the second moment, \( \theta(2, 4) - \theta(2, 2) \) is the variance, and \( (\theta(0, 2) - 1)^{1/2} \) is the coefficient of variation.

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7. es: Evans and Shaban’s estimator (Evans and Shaban, 1974, 1976)
8. r-s: Rukhin’s simple estimator (Rukhin, 1986)
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10. r-1o: Rukhin’s locally optimal estimator (Rukhin, 1986)
11. r-b: Rukhin’s Bayes estimator (Rukhin, 1986)
12. ev: El-Shaarawi and Viveros’ estimator (El-Shaarawi and Viveros, 1997)
14. sz-mm: Shen and Zhu’s MM estimator (Shen and Zhu, 2008)
15. sz-mb: Shen and Zhu’s MB estimator (Shen and Zhu, 2008)
16. l-ub: Longford’s UB estimator (Longford, 2009)
17. l-ms: Longford’s MS estimator (Longford, 2009)
18. ft: Fabrizi and Trivisano’s Simplified Bayes estimator (Fabrizi and Trivisano, 2012)
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42. zg-19: Zhang and Gou’s nineteenth estimator (Zhang and Gou, 2020)
lognormalmean

Value

estimated mean.

Author(s)

Jiangtao Gou

References


Examples

```r
library(fuel)
# Unbiased Estimation (Finney, 1941)
fuel::lognormalmean(data=c(1,4,6,7), estimator='unbiased')
# Longford's estimator, minimize the mean squared error (Longford, 2009)
fuel::lognormalmean(data=c(1,4,6,7), estimator='l-ms')
# Gou and Tamhane's estimator, Rukhin type (Gou and Tamhane, 2017)
fuel::lognormalmean(data=c(1,4,6,7), estimator='gt-r')
# Zhang and Gou's No.4 estimator (Zhang and Gou, 2020)
fuel::lognormalmean(data=c(1,4,6,7), estimator='zg-4')
```
Description

Lognormal models are also widely applied in various branches of natural, social and applied sciences. Given a pair of known constants in the parametric function for the statistics in the lognormal distribution, sample size, degree of freedom of the variance estimation of the log-transformed data, standardized variance of the sampling distribution of the log-transformed data, mean of the log-transformed data and standard deviation of the log-transformed data, this function returns an estimation for the lognormal distribution, including a total of thirty-nine different estimation methods, under a newly proposed unified framework in Zhang and Gou (2020).

Usage

```r
lognormalmedian(
  data,
  estimator,
  base = exp(1),
  n = length(data),
  m = n - 1,
  d = 1/n
)
```

Arguments

- `data`: original data vector
- `estimator`: a total of thirty-eight different estimation methods. See more descriptions in Section Details.
- `base`: the base with respect to which logarithms are computed. Defaults to e.
- `n`: sample size.
- `m`: degree of freedom of the variance estimation of the log-transformed data.
- `d`: standardized variance of the sampling distribution of the log-transformed data.

Details

Consider a parametric function in the original scale we are interested in estimating \( \theta(a, b) = \exp(a\mu + ba^2/2) \), where constants \( a \) and \( b \) are known. Specifically, \( \theta(1, 1) \) is the mean of the lognormal distribution, \( \theta(2, 4) \) is the second moment, \( \theta(2, 4) - \theta(2, 2) \) is the variance, and \( (\theta(0, 2) - 1)^{1/2} \) is the coefficient of variation.

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7. es: Evans and Shaban’s estimator (Evans and Shaban, 1974, 1976)
8. r-s: Rukhin’s simple estimator (Rukhin, 1986)
9. r-f: Rukhin’s estimator using Finney’s function (Rukhin, 1986)
10. r-lo: Rukhin’s locally optimal estimator (Rukhin, 1986)
11. r-b: Rukhin’s Bayes estimator (Rukhin, 1986)
12. ev: El-Shaarawi and Viveros’ estimator (El-Shaarawi and Viveros, 1997)
14. sz-mm: Shen and Zhu’s MM estimator (Shen and Zhu, 2008)
15. sz-mb: Shen and Zhu’s MB estimator (Shen and Zhu, 2008)
16. l-ub: Longford’s UB estimator (Longford, 2009)
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lognormalmedian

Value

estimated median.

Author(s)

Jiangtao Gou

References


Examples

library(fuel)

# Unbiased Estimation (Finney, 1941)
fuel::lognormalmedian(data=c(1,4,6,7), estimator='unbiased')

# Longford's estimator, minimize the mean squared error (Longford, 2009)
fuel::lognormalmedian(data=c(1,4,6,7), estimator='l-ms')

# Gou and Tamhane's estimator, Rukhin type (Gou and Tamhane, 2017)
fuel::lognormalmedian(data=c(1,4,6,7), estimator='gt-r')

# Zhang and Gou's No.4 estimator (Zhang and Gou, 2020)
fuel::lognormalmedian(data=c(1,4,6,7), estimator='zg-4')
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Usage

```r
lognormalsd(  
  data,  
  estimator,  
  base = exp(1),  
  n = length(data),  
  m = n - 1,  
  d = 1/n  
)
```

Arguments

data: original data vector

estimator: a total of thirty-eight different estimation methods. See more descriptions in Section Details.

base: the base with respect to which logarithms are computed. Defaults to e.

n: sample size.

m: degree of freedom of the variance estimation of the log-transformed data.

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lognormalsd

Value

estimated standard deviation.

Author(s)

Jiangtao Gou

References


Examples

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fuel::lognormalsd(data=c(1,4,6,7), estimator='unbiased')

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