Package ‘eel’

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Title Extended Empirical Likelihood
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Description Compute the extended empirical log likelihood ratio (Tsao & Wu, 2014) for the mean and parameters defined by estimating equations.
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R topics documented:

  eel-package ........................................................................ 2
  EEL .................................................................................. 3
  EEL_est .............................................................................. 5
  EMLLogLR ........................................................................... 6
  exp_factor .......................................................................... 7
  exp_factor_est ...................................................................... 8
  prime_image ......................................................................... 9
  prime_image_est ................................................................... 10
  print.EEL ............................................................................ 11
  summary.EEL ...................................................................... 12

Index 14
Description

Compute the extended empirical log likelihood ratio (Tsao & Wu, 2014) for the mean and parameters defined by estimating equations.

Details

Index of help topics:

- EEL: Extended empirical log likelihood ratio for the mean
- EEL_est: Extended empirical log likelihood ratio for parameters defined by estimating equations
- EMlogLR: Original empirical log likelihood ratio
- eel-package: Extended Empirical Likelihood
- exp_factor: Calculating expansion factor for EEL for the mean
- exp_factor_est: Calculating expansion factor for EEL for parameters defined by estimating equations
- prime_image: Calculating prime-image based on similarity mapping for the mean
- prime_image_est: Calculating prime-image based on similarity mapping for parameters defined by estimating equations
- print.EEL: Printing EEL objects
- summary.EEL: Summarizing EEL objects

The extended empirical log likelihood ratio for the mean is computed by calling the function EEL(), and that for the parameter defined estimating equations is computed by calling the function EEL_est(). This package requires pre-installation of two packages "emplik" and "rootSolve". These are needed for computing the prime image of a point theta as well as the final extended empirical log likelihood ratio value as described in Tsao and Wu (2013, 2014). Only the first-order EEL discussed Tsao and Wu (2013, 2014) is included in this package.

Author(s)

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References


See Also

EMLogLR, EEL, EEL_est, exp_factor, prime_image, prime_image_est, exp_factor_est,

Examples

# EXAMPLE: computing the EEL for the mean of a bivariate random variable
# Generating a sample of n=40 bivariate observations.
# For this example, we do this through a univariate normal random number generator.

uninorm<- rnorm(40*2,5,1)
multnorm<-matrix(uninorm,ncol=2)

# To calculate the EEL for a point theta=c(5,2), use
EEL(x=multnorm,theta=c(5,2))

# an example to use the EEL_est in the case of estimating equation

# generate regression dataset
# random variable x
dmx2<-runif(100,min=0,max=100)
dmx<-matrix(dmx2,100,2)
dmx[,1]=1
dmx[,2]=dmx2

# set the initial beta value
beta0<-c(1,2)

# generate random errors and calculate the response variable
errdata<-rnorm(100,0,1)
ydata<-dmx%*%beta0+errdata

# calculate the maximum empirical likelihood estimates
beta_lse<-solve(t(dmx)%*%dmx)%*%(t(dmx)%*%ydata)

num=EEL_est(x=dmx,theta=c(1,2),theta_tilda=beta_lse,
        "gx<-matrix(0,nrow=100,ncol=2)
        for(i in 1:2){gx[,i]<-as.matrix(theta[i])
        "gx")
summary(num)
Description

Calculate the extended empirical log likelihood ratio for a multi-dimensional mean

Usage

EEL(x, theta)

## Default S3 method:
EEL(x,theta)

Arguments

x                Data matrix.
theta            The value at which the extended empirical likelihood is to be evaluated.

Value

An object of class EEL, basically a list including elements

theta            the value at which the extended empirical likelihood is to be evaluated;
prime            the prime-image inside the convex hull for the point theta;
estimating equation the estimating equation here is "x-theta";
expansion        the value of the expansion factor gamma;
oel_log          the original empirical log likelihood ratio value;
eel_log          the extended empirical log likelihood ratio value.

Author(s)

Yu Zhang & Fan Wu

See Also

EMLogLR, exp_factor, prime_image, print.EEL, summary.EEL, EEL_est

Examples

# EXAMPLE: computing the EEL for the mean of a bivariate random variable
# Generating a sample of n=40 bivariate observations.
# For this example, we do this through a univariate normal random number generator.

uninorm<- rnorm(40*2,5,1)
multnorm<-matrix(uninorm,ncol=2)

# To calculate the EEL for a point theta=c(5,3), use
EEL(x=multnorm,theta=c(5,3))
**Description**

Calculate the extended empirical log likelihood ratio for parameters defined by estimating equations.

**Usage**

```r
EEL_est(x, theta, theta_tilda, equation)
```

## Default S3 method:

```r
EEL_est(x, theta, theta_tilda, equation)
```

**Arguments**

- **x**: Data matrix.
- **theta**: Value at which the EEL for the parameters defined by estimating equations will be evaluated.
- **theta_tilda**: The maximum empirical likelihood estimator of the unknown parameter.
- **equation**: The estimating equation, must be put inside quotation marks and has to be a function of theta.

**Value**

An object of class `EEL`, basically a list including elements:

- **theta**: Value at which the EEL for the parameters defined by estimating equations will be evaluated.
- **prime**: The prime-image inside the convex hull for the point theta.
- **estimating equation**: The estimating equation.
- **expansion**: The value of the expansion factor gamma.
- **oel_log**: The original empirical log likelihood ratio value.
- **eel_log**: The extended empirical log likelihood ratio value.

**Author(s)**

Yu Zhang

**See Also**

`EMLogLR`, `exp_factor_est`, `prime_image_est`, `print.EEL`, `summary.EEL`, `eel-package`, `EEL`
Examples

# EXAMPLE: computing the EEL for the mean of a bivariate random variable
# Generating a sample of n=40 bivariate observations.
# For this example, we do this through a univariate normal random number generator.

uninorm <- rnorm(40*2,5,1)
multnorm <- matrix(uninorm,nrow=100,ncol=2)

# To calculate the EEL for a point theta=c(5,3), use
theta_tilda <- colMeans(multnorm),theta=c(5,3)),theta_tilda, "x-theta")

emloglr

Original empirical log likelihood ratio

Description

The function extracts the empirical log likelihood ratio value produced by el.test() function from package "emplik".

Usage

EMLogLR(x, mean)

Arguments

x Data matrix.
mean The mean value to be evaluated.

Value

The function will return a numerical value representing the original empirical log likelihood ratio.

Author(s)

Yu Zhang & Fan Wu

See Also

EEL

Examples

x=rnorm(50,0,1)
# find the empirical log likelihood ratio at point 0
EMLogLR(x,0)
Description

The function calculates the first order expansion factor of EEL for the mean.

Usage

exp_factor(x, theta)
### Default S3 method:
exp_factor(x, theta)

Arguments

x  Data matrix of interest.
theta  The value to be evaluated.

Details

The first order expansion factor for calculating EEL is defined as

$$\gamma(n, l(\theta)) = 1 + \frac{l(\theta)}{2n}.$$

Value

The function will return a numerical value representing the value of the expansion factor calculated.

Author(s)

Fan Wu & Yu Zhang

References


See Also

EEL, prime_image, exp_factor_est

Examples

x=rnorm(400,0,3)
exp_factor(x,0)
exp_factor_est  

Calculating expansion factor for EEL for parameters defined by estimating equations

Description

The function calculates the first order expansion factor of EEL for the parameters defined by estimating equations.

Usage

exp_factor_est(x, theta, equation)

## Default S3 method:
exp_factor_est(x, theta, equation)

Arguments

- **x**: Data Matrix.
- **theta**: The value to be evaluated.
- **equation**: The estimating equation by which the parameters are defined.

Details

The first order expansion factor for calculating EEL is defined as

\[ \gamma(n, l(\theta)) = 1 + \frac{l(\theta)}{2n}. \]

The estimating equation input has to be a function of theta.

Value

The function will return a numerical value representing the value of the expansion factor calculated.

Author(s)

Yu Zhang and Fan Wu

References


See Also

eel-package, exp_factor, EEL_est, prime_image_est
Examples

```r
# generate data with theoretical mean 2 and standard deviation 1
x = rnorm(100, 2, 1)
exp_factor_est(x = x, theta = 2, equation = "x-theta")
```

Description

The function calculates the prime image of the given point based on the similarity mapping defined in the EEL calculation.

Usage

```r
prime_image(theta_tilda, theta, x)
```

## Default S3 method:
```r
prime_image(theta_tilda, theta, x)
```

Arguments

- `theta_tilda`: Sample mean or the maximum empirical likelihood estimate of the estimating equations.
- `theta`: Value to be evaluated.
- `x`: Data matrix.

Details

The prime image was found by solving the equation

\[ f(\zeta') = \zeta'. \]

See the reference paper for details.

Value

The function returns a vector, with the same length as the mean, representing the prime image of the point theta, based on the similarity mapping defined in EEL calculation.

Author(s)

Fan Wu and Yu Zhang

References


The function calculates the prime image of a given point based on the similarity mapping defined in the EEL calculation.

Usage

```r
prime_image_est(theta_tilda, theta, x, equation)
```

## Default S3 method:
```r
prime_image_est(theta_tilda, theta, x, equation)
```

### Arguments

- **theta_tilda**: The maximum empirical likelihood estimates for parameters defined by estimating equations.
- **theta**: The value to be evaluated.
- **x**: Data Matrix.
- **equation**: The estimating equation by which the parameters are defined, must be put as a function of theta.

### Details

The prime image was found by solving the equation

$$f(\zeta'') = \zeta'.$$

See the reference paper for details.

### Value

The function returns a vector, with the same dimension as the mean, representing the prime image of the point theta, based on the similarity mapping defined in EEL calculation.
Author(s)
Yu Zhang

References

See Also
EEL.exp_factor_est,EEL_est,prime_image

Examples
x=rnorm(50,6,2)
# find the prime image of true mean
prime_image_est(theta_tilda=mean(x),theta=6,x=x,"x-theta")

print.EEL

Printing EEL objects

Description
The function prints the extended empirical log likelihood ratio.

Usage
## S3 method for class 'EEL'
print(x,...)

Arguments
x EEL object.
... Further arguments passed to or from other methods.

Value
The function prints the extended empirical log likelihood ratio value of the EEL object.

Author(s)
Yu Zhang
See Also

EEL

Examples

# EXAMPLE: computing the EEL for the mean of a bivariate random variable
# Generating a sample of n=40 bivariate observations.
# For this example, we do this through a univariate normal random number generator.

uninorm<- rnorm(40*2,5,1)
multnorm<-matrix(uninorm,ncol=2)

# To calculate the EEL for a point theta=c(5,3), use
obj=EEL(x=multnorm,theta=c(5,3))

print(obj)

summary.EEL  Summarizing EEL objects

Description

The function prints a summary of EEL objects.

Usage

## S3 method for class 'EEL'
summary(object,...)

Arguments

object    An EEL object.
...       Additional arguments affecting the summary produced.

Value

The function prints a summary of EEL objects including
theta           the point at which the EEL is to be evaluated;
estimating equation    the estimating equation at which the parameters are defined;
log oel ratio    empirical log likelihood ratio for the point theta;
prime image       prime-image of theta defined by the similarity mapping in EEL calculation;
exansion factor    value of the expansion factor
                   \( \gamma(x, \theta) \);
log eel ratio     value of the extended empirical log likelihood ratio.
Author(s)
Yu Zhang

See Also
EEL.print.EEL,EEL_est

Examples

# EXAMPLE: computing the EEL for the mean of a bivariate random variable
# Generating a sample of n=40 bivariate observations.
# For this example, we do this through a univariate normal random number generator.

uninorm<- rnorm(40*2,5,1)
multnorm<-matrix(uninorm,ncol=2)

# To calculate the EEL for a point theta=c(5,3), use
obj=EEL(x=multnorm,theta=c(5,3))
summary(obj)
Index

*Topic EEL
  EEL_est, 5
  exp_factor_est, 8
  prime_image_est, 10
  print.EEL, 11
  summary.EEL, 12
*Topic Empirical
  EEL, 3
  eel-package, 2
*Topic Estimating
  EEL_est, 5
*Topic Likelihood
  eel-package, 2
*Topic expansion
  exp_factor, 7
*Topic image
  prime_image, 9
  prime_image_est, 10
*Topic mapping
  exp_factor, 7
  prime_image, 9
*Topic nonparametric
  EEL, 3
*Topic printing
  print.EEL, 11
*Topic summary
  summary.EEL, 12

EEL, 3, 3, 5–7, 10–13
eel-package, 2
EEL_est, 3, 4, 5, 8, 11, 13
EMLgLR, 3–5, 6
exp_factor, 3, 4, 7, 8, 10
exp_factor_est, 3, 5, 7, 8, 11

prime_image, 3, 4, 7, 9, 11
prime_image_est, 3, 5, 8, 10, 10
print.EEL, 4, 5, 11, 13

summary.EEL, 4, 5, 12