Package ‘ESTER’

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Title Efficient Sequential Testing with Evidence Ratios
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Description An implementation of sequential testing that uses evidence ratios computed from the weights of a set of models. These weights correspond either to Akaike weights computed from the Akaike Information Criterion (AIC) or the Bayesian Information Criterion (BIC) and following Burnham & Anderson (2004, <doi:10.1177/0049124104268644>) recommendations, or to pseudo-BMA weights computed from the WAIC or the LOO-IC of models fitted with ‘brms’ and following Yao et al. (2017, <arXiv:1704.02030v3>).

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URL https://github.com/lnalborczyk/ESTER

BugReports https://github.com/lnalborczyk/ESTER/issues
Suggests knitr, rmarkdown
VignetteBuilder knitr

NeedsCompilation no

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R topics documented:

- aic ..................................................... 2
- analysER ............................................. 3
- bic ..................................................... 4
- distER .................................................. 4
- ESTER .................................................. 5
- ictab .................................................... 6
- plot.simER ............................................. 7
- seqER .................................................... 8
- seqERboot ............................................. 9
- simER .................................................... 10

Index 12

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### aic

**Computes the Akaike Information Criterion**

**Description**

Computes the Akaike Information Criterion of a model. Except when the number of observations is much larger than the number of parameters (i.e., n / k > 40), we apply the second-order bias correction for small samples (AICc), as suggested by Burnham & Anderson (2002, 2004).

**Usage**

```r
aic(mod)
```

**Arguments**

- `mod` A fitted model of class `lm` or `merMod`.

**Author(s)**

Ladislas Nalborczyk <<ladislas.nalborczyk@gmail.com>>

**References**


**See Also**

bic, ictab
Examples

```r
data(mtcars)
mod1 <- lm(mpg ~ cyl, mtcars)
aic(mod1)
```

---

analysER

### Analysing the results of simulations ran with simER

Analysing the results of simulations ran with simER. It computes the average sample number (ASN) at which the boundary is attained (either the lower or the upper one), the percentage of hits of the lower boundary as well as hits of the upper boundary, and the percentage of trajectories that did not hit none of the boundaries.

#### Usage

```r
analysER(sim)
```

#### Arguments

- `sim` A simER or a compER object.

#### Value

An object of class `data.frame`, which contains the average sample number (ASN) at which the boundary is attained (either the lower or the upper one), the percentage of hits of the lower boundary as well as hits of the upper boundary, and the percentage of trajectories that did not hit none of the boundaries (and thus end at `nmax`).

#### Author(s)

Ladislas Nalborczyk <<[ladislas.nalborczyk@gmail.com]>>

#### See Also

- `simER`

#### Examples

```r
## Not run:
library(ESTER)
sim <- simER(cohensd = 0.8, nmin = 20, nmax = 100, boundary = 10, nsims = 100, ic = bic)
analysER(sim)

## End(Not run)
```
bic

Computes the Bayesian Information Criterion

Description
Computes the Bayesian Information Criterion of a model (Schwarz, 1978).

Usage
bic(mod)

Arguments
mod A fitted model of class lm or merMod.

Author(s)
Ladislas Nalborczyk <ladislas.nalborczyk@gmail.com>

References

See Also
aic, ictab

Examples

data(mtcars)
mod1 <- lm(mpg ~ cyl, mtcars)
bic(mod1)

distER

Simulating many sequential testing with evidence ratios and plotting their distribution

Description
Simulating many sequential evidence ratios using simER, keeps the last of each simulation, and plotting their distribution.

Usage
distER(cohensd, nmin, nmax, nsims, ic = bic)
ESTER

Arguments

- cohensd: Expected effect size
- nmin: Minimum sample size from which start computing ERs
- nmax: Maximum sample size at which stop computing ERs
- nsims: Number of experiments to simulate.
- ic: Indicates whether to use the aic or the bic

Author(s)

Ladislas Nalborczyk <<ladislas.nalborczyk@gmail.com>>

See Also

simER

Examples

```r
## Not run: distER(cohensd = 0.6, nmin = 20, nmax = 100, nsims = 100, ic = bic)
```

Description

The **ESTER** package implements sequential testing based on evidence ratios computed from the Akaike weights of a set of models. These weights are being computed using either the Akaike Information Criterion (AIC) or the Bayesian Information Criterion (BIC).

Details

See vignette("ESTER") for a general introduction and overview.

Author(s)

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See Also

ictab, simER, seqER
ictab

**Description**

Returns a table with weights of a set of models, based on various information criteria. Currently, ictab supports the computation of Akaike weights from the `aic` or the `bic` computed on `lm` or `merMod` models, as well as the computation of pseudo-BMA weights, computed from the WAIC or LOOIC of `brmsfit` models.

**Usage**

```r
ictab(mods, ic, ...)
```

**Arguments**

- `mods`: Should be a named list of models, of class `lm`, `merMod` or `brmsfit`.
- `ic`: Indicates which information criterion to use. Current supported information criteria include `aic` and `bic` for `lm` and `merMod` models, as well as `WAIC` and `LOO` for `brmsfit` models.
- `...`: Additional parameters to be passed to `brms::WAIC` or `brms::LOO` functions.

**Value**

An object of class `data.frame`, which contains the value of the information criterion (either AIC, BIC, WAIC or LOOIC), the number of parameters (k for AIC and BIC or p for WAIC or LOOIC), the delta IC (for AIC and BIC) or the elpd for models compared with WAIC or LOOIC, and the weight of each model (Akaike weights for AIC or BIC and pseudo-BMA weights for WAIC or LOOIC).

**Author(s)**

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**References**


**See Also**

`aic`, `bic`
Examples

```r
library(ESTER)
data(mtcars)
mod1 <- lm(mpg ~ cyl, mtcars)
mod2 <- lm(mpg ~ cyl + vs, mtcars)
mod3 <- lm(mpg ~ cyl + vs + I(vs^2), mtcars)
mod4 <- lm(mpg ~ cyl * vs, mtcars)
mods <- list(mod1 = mod1, mod2 = mod2, mod3 = mod3, mod4 = mod4)
ictab(mods, aic)
ictab(mods, bic)

## Not run:
library(brms)
mod1 <- brm(mpg ~ cyl, mtcars)
mod2 <- brm(mpg ~ cyl + vs, mtcars)
mods <- list(m1 = mod1, m2 = mod2)
ictab(mods, LOO, reloo = TRUE, k_threshold = 0.6, cores = 2)

## End(Not run)
```

---

**plot.simER**  
*Plotting the results of simER*

**Description**

Plotting the results of simER.

**Usage**

```r
## S3 method for class 'simER'
plot(x, log = TRUE, hist = TRUE, ...)
```

**Arguments**

- `x`  
  A simER object

- `log`  
  Should the y-axis be log-transformed ?

- `hist`  
  Should plot the histogram of simulations hitting either the lower, the upper boundary, or stopping at nmax ?

- `...`  
  Further arguments passed to `plot.default`

**Author(s)**

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seqER  

**Description**

Computes sequential evidence ratios, either based on the AIC or the BIC. Supported models currently include `lm`, `merMod`, or `brmsfit` models. When data involve repeated measures (and so multiple lines per subject), a column indicating the subject "id" should be provided to the id argument. If nothing is passed to the id argument, seqER will suppose that there is only one observation (i.e., one line) per subject.

**Usage**

```r
seqER(ic = bic, mod1, mod2, nmin = 10, id = NULL, boundary = Inf, blind = FALSE, nsims = NULL)
```

**Arguments**

- `ic` Indicates whether to use the aic or the bic.
- `mod1` A model of class `lm` or `lmerMod`.
- `mod2` A model of class `lm` or `lmerMod` (of the same class of mod1).
- `nmin` Minimum sample size from which start to compute sequential evidence ratios.
- `id` If applicable (i.e., repeated measures), name of the "id" column of your dataframe, in character string.
- `boundary` The Evidence Ratio (or its reciprocal) at which the run is stopped as well
- `blind` If true, the function only returns a "continue or stop" message
- `nsims` Number of permutation samples to evaluate (is ignored if blind = TRUE)

**Author(s)**

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**See Also**

`simER`

**Examples**

```r
## Not run:
data(mtcars)
mod1 <- lm(mpg ~ cyl, mtcars)
mod2 <- lm(mpg ~ cyl + disp, mtcars)
seqER(ic = bic, mod1, mod2, nmin = 10)
# Example with ten permutation samples
data(mtcars)
```
seqERboot

Computes sequential evidence ratios for a given data set and permutation samples

Description
Computes sequential evidence ratios for a given data set as well as for order_nb random permutations of this dataset. When data involve repeated measures (and so multiple lines per subject), a column indicating the subject "id" should be provided to the id argument. If nothing is passed to the id argument, seqERboot will suppose that there is only one observation (i.e., one line) per subject.

Usage
seqERboot(ic, mod1, mod2, nmin, id = NULL, order_nb)

Arguments
ic Indicates whether to use the aic or the bic.
mod1 A model of class lm or lmerMod.
mod2 A model of class lm or lmerMod (of the same class of mod1).
nmin Minimum sample size from which start to compute sequential evidence ratios.
id

If applicable (i.e., repeated measures), name of the "id" column of your dataframe, in character string.

order_nb

Number of permutation samples to evaluate.

Author(s)

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See Also

seqER

Examples

## Not run:
data(mtcars)
mod1 <- lm(mpg ~ cyl, mtcars)
mod2 <- lm(mpg ~ cyl + disp, mtcars)
seqERboot(ic = bic, mod1, mod2, nmin = 10, order_nb = 20)
## End(Not run)

simER

Simulates sequential testing with evidence ratios

Description

Simulates one or many sequential testing with evidence ratios from independent two-groups comparisons, as a function of sample size and standardized mean difference. Evidence ratios are computed from the so-called Akaike weights from either the Akaike Information Criterion or the Bayesian Information Criterion.

Usage

simER(cohensd = 0, nmin = 20, nmax = 100, boundary = 10, nsims = 20, ic = bic, cores = 2, verbose = FALSE)

Arguments

cohensd Expected effect size
nmin Minimum sample size from which start computing ERs
nmax Maximum sample size at which stop computing ERs
boundary The Evidence Ratio (or its reciprocal) at which the run is stopped as well
nsims Number of simulated samples (should be dividable by cores)
ic Indicates whether to use the aic or the bic
cores Number of parallel processes. If cores is set to 1, no parallel framework is used (default is two cores).
verbose Show output about progress
Value

An object of class `data.frame`, which contains...

Author(s)

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See Also

`ictab`, `analysER`

Examples

```r
## Not run:
sim <- simER(cohensd = 0.8, nmin = 20, nmax = 100, boundary = 10, nsims = 100, ic = bic, cores = 2, verbose = TRUE)
plot(sim, log = TRUE, hist = TRUE)

## End(Not run)
```
Index

aic, 2, 4, 6
analysER, 3, 11

bic, 2, 4, 6

distER, 4

ESTER, 5
ESTER-package (ESTER), 5

ictab, 2, 4, 5, 6, 11

plot.simER, 7

seqER, 5, 8, 10
seqERboot, 9
simER, 3, 5, 8, 10