Package: aedl (via r-universe)

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Type Package

Title Almost-Exact Inference for the DerSimonian-Laird Test Statistic

Version 0.1.0

Description Implements almost-exact inference for the DerSimonian-Laird test statistic in the normal-normal random-effects meta-analysis model, as described in Hanada and Sugimoto (2023) <doi:10.1007/s10463-022-00844-4>. The method approximates the distribution of the DerSimonian-Laird test statistic by combining the distribution of the untruncated DerSimonian-Laird estimator of the between-study variance with a conditional normal approximation. Methods based on a plug-in between-study variance and a corrected heterogeneity measure are provided.

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`aedl` *Almost-exact inference for the DerSimonian-Laird test statistic*

Description

`aedl()` computes a DerSimonian-Laird point estimate and performs almost-exact inference for the DerSimonian-Laird test statistic in the normal-normal random-effects meta-analysis model.

Usage

```
aedl(
  yi,
  vi,
  alpha = 0.05,
  method = c("plugin", "i2c"),
  side = 2,
  a = 0,
  b = 1,
  t_grid = seq(-20, 20, by = 0.01),
  nsim = 10000,
  nsim_chi = 1e+05,
  n_tau = 1000,
  I2_grid = seq(0, 0.99, by = 0.01),
  normalize_cdf = TRUE,
  seed = NULL,
  ...
)
```

Arguments

`yi`	Numeric vector of study-level effect estimates.
`vi`	Numeric vector of known within-study variances.
`alpha`	Significance level. The confidence level is `1 - alpha`.
`method`	Method used to choose the heterogeneity value for constructing the almost-exact distribution. `"plugin"` corresponds to `exactDL` in the supplemental program of Hanada and Sugimoto (2023) and uses the DerSimonian-Laird estimate $\hat{\tau}^2_{DL}$. `"i2c"` uses a corrected heterogeneity measure I^2_c.

side	Test side, either 1 or 2.
a, b	Lower and upper bounds of the uniform prior on I^2 used when method = "i2c".
t_grid	Grid for the DerSimonian-Laird test statistic.
nsim	Number of Monte Carlo samples for conditional quantities.
nsim_chi	Number of Monte Carlo samples for the chi-square mixture.
n_tau	Number of grid intervals for the untruncated DL estimator.
I2_grid	Grid for I^2 calculations.
normalize_cdf	Logical; if TRUE, normalize the CDF constructed on the finite numerical grid so that its maximum is one.
seed	Optional random seed. If supplied, it is set for this call.
...	Reserved for future extensions.

Details

For method = "plugin", the distribution of the DL test statistic is constructed using $\hat{\tau}^2_{DL}$ as the value of τ^2.

For method = "i2c", the implementation evaluates $p(\hat{I}^2_{\mathrm{obs}} \mid I^2)$ on I2_grid by taking the row of the simulated conditional distribution corresponding to the observed $\hat{I}^2$. It then computes I^2_c under a uniform prior on [a, b] and uses the corresponding τ^2_c to construct the almost-exact distribution.

The numerical implementation is a streamlined version of the computational procedure shown in the supplemental material of Hanada and Sugimoto (2023). It has been checked against the original supplemental program in development scripts.

Value

An object of class "aedl" with elements estimate, se, ci.lb, ci.ub, pval, tau2, tau2_for_dist, I2hat, I2c, tau2c, crit, method, and call.

Examples

```
yi <- c(0.10, 0.25, 0.05, 0.30)
vi <- c(0.04, 0.05, 0.03, 0.06)
res <- aedl(
  yi, vi,
  t_grid = seq(-6, 6, by = 0.2),
  nsim = 100,
  nsim_chi = 500,
  n_tau = 50,
  seed = 1
)
res
confint(res)
```

`aedl_stat_density` *Approximate density of the DL test statistic*

Description

`aedl_stat_density()` evaluates the almost-exact density approximation of the DerSimonian-Laird test statistic on a user-supplied grid.

Usage

```
aedl_stat_density(
  t_grid,
  vi,
  tau2,
  theta = 0,
  nsim = 10000,
  nsim_chi = 1e+05,
  n_tau = 1000
)
```

Arguments

`t_grid`	Numeric grid for the DerSimonian-Laird test statistic.
`vi`	Numeric vector of known within-study variances.
`tau2`	Non-negative value of the between-study variance.
`theta`	Mean parameter used in the conditional normal approximation.
`nsim`	Number of Monte Carlo samples for conditional quantities.
`nsim_chi`	Number of Monte Carlo samples for the chi-square mixture.
`n_tau`	Number of grid intervals for the untruncated DL estimator.

Value

A list with grid values `x`, density values `y`, and auxiliary quantities used in the approximation.

Examples

```
vi <- c(0.04, 0.05, 0.03, 0.06)
d_stat <- aedl_stat_density(
  t_grid = seq(-4, 4, by = 0.5),
  vi = vi,
  tau2 = 0.01,
  nsim = 100,
  nsim_chi = 500,
  n_tau = 50
)
str(d_stat[c("x", "y")])
```

aedl_tau2_density *Approximate density of the untruncated DL tau-squared estimator*

Description

aedl_tau2_density() evaluates the chi-square-mixture approximation used internally for the untruncated DerSimonian-Laird estimator of the between-study variance.

Usage

```
aedl_tau2_density(vi, tau2, nsim_chi = 1e+05, n_tau = 1000)
```

Arguments

vi	Numeric vector of known within-study variances.
tau2	Non-negative value of the between-study variance.
nsim_chi	Number of Monte Carlo samples for the chi-square mixture.
n_tau	Number of grid intervals for the untruncated DL estimator.

Value

A list with grid values x, density values y, and auxiliary quantities used in the approximation.

Examples

```
vi <- c(0.04, 0.05, 0.03, 0.06)
d_tau <- aedl_tau2_density(
  vi = vi,
  tau2 = 0.01,
  nsim_chi = 500,
  n_tau = 50
)
str(d_tau[c("x", "y")])
```

confint.aedl *Confidence interval for an aedl object*

Description

Confidence interval for an aedl object

Usage

```
## S3 method for class 'aedl'
confint(object, parm = NULL, level = NULL, ...)
```

Arguments

`object`	An object of class `"aedl"`.
`parm`	Unused; included for S3 compatibility.
`level`	Confidence level. Currently must match the level used when fitting `object`; a different level requires refitting.
`...`	Unused.

Value

A two-column matrix with confidence limits.

`print.aedl` *Print an aedl object*

Description

Print an aedl object

Usage

```
## S3 method for class 'aedl'
print(x, digits = max(3, getOption("digits") - 3), ...)
```

Arguments

`x`	An object of class `"aedl"`.
`digits`	Number of significant digits to print.
`...`	Unused.

Value

Invisibly returns `x`, the input object of class `"aedl"`.

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