Package ‘messi’

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Type  Package
Title  Mediation Analysis with External Summary-Level Information on Total Effect
Version  0.1.1
Description  Fits the hard constraint, soft constraint, and unconstrained models in Boss et al. (2023) <arXiv:2306.17347> for mediation analyses with external summary-level information on the total effect.
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LazyData  true
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constrained.unpenalized

Estimate hard constraint model parameters using cyclical coordinate descent.

Description

Estimate hard constraint model parameters using cyclical coordinate descent.

Usage

constrained.unpenalized(
  Y,
  M,
  A,
  C = NULL,
  T.hat.external,
  err.tol.out = 1e-08,
  err.tol.med = 1e-08,
  max.itr = 10000
)

Arguments

Y A (n x 1) continuous outcome vector.
M A (n x p_m) matrix of mediators.
A A (n x 1) vector of exposures.
C A (n x p_c) matrix of confounders and adjustment covariates. If there are no confounders or adjustment covariates set C = NULL.
T.hat.external External estimate of the total effect.
err.tol.out Termination condition for cyclical coordinate descent algorithm with respect to the outcome model parameters.
err.tol.med Termination condition for cyclical coordinate descent algorithm with respect to the mediator model parameters.
max.itr Maximum number of iterations for cyclical coordinate descent algorithm.

Value

A list containing point estimates of the hard constraint model parameters and an indicator of whether the algorithm converges.
Simulated data with real mediation effect

Description

Simulated data with real mediation effect

Usage

Med

Format

An object of class list of length 8.

Examples

data(Med)

Implementation of Mediation with External Summary Statistics Information (MESSI) from Boss et al. (2023).

Description

Implementation of Mediation with External Summary Statistics Information (MESSI) from Boss et al. (2023).

Usage

messi(
    Y,
    M,
    A,
    C = NULL,
    method = "Soft EB",
    T.hat.external,
    var.T.hat.external,
    n.boot = 200,
    s2.fixed = NULL
  )
Arguments

Y A (n x 1) continuous outcome vector.
M A (n x p_m) matrix of mediators.
A A (n x 1) vector of exposures.
C A (n x p_c) matrix of confounders and adjustment covariates. If there are no confounders or adjustment covariates set C = NULL.
method A string specifying which method to use. Options include 'Unconstrained', 'Hard', 'Soft EB', and 'Soft Fixed'. Default is 'Soft EB'.
T.hat.external External estimate of the total effect. Set to NULL if method = 'Unconstrained'.
var.T.hat.external Estimated variance of the external estimator of the total effect. Set to NULL if method = 'Unconstrained' or method = 'Hard'.
n.boot Number of parametric bootstrap draws for obtaining quantile-based confidence intervals for the TE and NDE. Relevant for method = 'Soft EB' and method = 'Soft Fixed'. Can set to NULL for method = 'Unconstrained' and method = 'Hard'.
s2.fixed Option to specify the tuning parameter $s^2$ in the soft constraint model. Only use if method = 'Soft Fixed'.

Details

The Soft EB method should be the default method if the user is not sure which method to use.

Value

A list containing the (1) point estimates and confidence intervals for the natural direct effect, the natural indirect effect, and the total effect (2) point estimates for all mediation model parameters (3) the asymptotic variance covariance matrix corresponding to alpha_a and beta_m.

Examples

data(Med)

Y = Med$Y
M = Med$M
A = Med$A
C = Med$C
T.hat.external = Med$T.hat.external
var.T.hat.external = Med$var.T.hat.external
test <- messi(Y = Y, M = M, A = A, C = C, method = 'Unconstrained', T.hat.external = T.hat.external, var.T.hat.external = var.T.hat.external, s2.fixed = NULL)
n = Med$n
p = Med$p
plot_messi(n = n, alpha.a.hat = test$alpha.a.hat, beta.m.hat = test$beta.m.hat, labels = paste0("M",1:p), asym.var.mat = test$asym.var.mat)
nullMed

Simulated data with null mediation effect

Description
Simulated data with null mediation effect

Usage
nullMed

Format
An object of class list of length 4.

Examples
data(nullMed)

plot_messi
Forestplot to Summarize Estimation and Inference on alpha_a and beta_m.

Description
Forestplot to Summarize Estimation and Inference on alpha_a and beta_m.

Usage
plot_messi(n, alpha.a.hat, beta.m.hat, labels, asym.var.mat)

Arguments
- n: Sample size of the analysis
- alpha.a.hat: Estimate of alpha_a, a (p_m x 1) vector.
- beta.m.hat: Estimate of beta_m, a (p_m x 1) vector.
- labels: A (p_m x 1) vector of mediator names. Make sure that the labels are in the same order as the mediators appear in the design matrix.
- asym.var.mat: Joint asymptotic variance-covariance matrix of alpha_a and beta_m, a (2p_m x 2p_m) matrix.
Value

Data frames and forestplots summarizing alpha\_a and beta\_m estimation.

Examples

data(Med)

Y = Med$Y
M = Med$M
A = Med$A
C = Med$C
T.hat.external = Med$T.hat.external
var.T.hat.external = Med$var.T.hat.external

test <- messi(Y = Y, M = M, A = A, C = C, method = 'Unconstrained', T.hat.external = T.hat.external,
var.T.hat.external = var.T.hat.external, s2.fixed = NULL)

n = Med$n
p = Med$p

plot_messi(n = n, alpha.a.hat = test$alpha.a.hat, beta.m.hat = test$beta.m.hat,
labels = paste0("M",1:p), asym.var.mat = test$asym.var.mat)

rand.eff.coord.desc.unpenalized

Cyclical coordinate descent algorithm for the M-step in the EM Algorithm for the maximizing the soft constraint model likelihood.

Description

Cyclical coordinate descent algorithm for the M-step in the EM Algorithm for the maximizing the soft constraint model likelihood.

Usage

rand.eff.coord.desc.unpenalized(
Y,
M,
A,
C = NULL,
first.moment,
second.moment,
err.tol.out = 1e-08,
err.tol.med = 1e-08,
max.itr = 10000
)
Arguments

Y A (n x 1) continuous outcome vector.
M A (n x p_m) matrix of mediators.
A A (n x 1) vector of exposures.
C A (n x p_c) matrix of confounders and adjustment covariates. If there are no confounders or adjustment covariates set C = NULL.

first.moment Posterior expectation of the total effect parameter.
second.moment Posterior expectation of the squared total effect parameter.
err.tol.out Termination condition for cyclical coordinate descent algorithm with respect to the outcome model parameters.
err.tol.med Termination condition for cyclical coordinate descent algorithm with respect to the mediator model parameters.
max.itr Maximum number of iterations for cyclical coordinate descent algorithm.

Value

A list containing point estimates of the soft constraint model parameters and an indicator of whether the algorithm converges.

Description

Estimate soft constraint model parameters using the EM algorithm.

Usage

rand.eff.unpenalized(
  Y,
  M,
  A,
  C = NULL,
  rand.eff.mean,
  rand.eff.var,
  T.hat.external = T.hat.external,
  var.T.hat.external = var.T.hat.external,
  err.tol.out = 1e-08,
  err.tol.med = 1e-08,
  max.itr = 10000
)
Arguments

Y  A (n x 1) continuous outcome vector.
M  A (n x p_m) matrix of mediators.
A  A (n x 1) vector of exposures.
C  A (n x p_c) matrix of confounders and adjustment covariates. If there are no
confounders or adjustment covariates set C = NULL.

rand.eff.mean  Mean of the random effects distribution for the internal total effect parameter.
rand.eff.var  Variance of the random effects distribution for the internal total effect parameter.
T.hat.external  External estimate of the total effect.
var.T.hat.external  Estimated variance of the external total effect estimator.
err.tol.out  Termination condition for cyclical coordinate descent algorithm with respect to
the outcome model parameters.
err.tol.med  Termination condition for cyclical coordinate descent algorithm with respect to
the mediator model parameters.
max.itr  Maximum number of iterations for cyclical coordinate descent algorithm.

Value

A list containing point estimates of the unconstrained model parameters.

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unconstrained.unpenalized

Estimate unconstrained model parameters.

Description

Estimate unconstrained model parameters.

Usage

unconstrained.unpenalized(Y, M, A, C = NULL)

Arguments

Y  A (n x 1) continuous outcome vector.
M  A (n x p_m) matrix of mediators.
A  A (n x 1) vector of exposures.
C  A (n x p_c) matrix of confounders and adjustment covariates. If there are no
confounders or adjustment covariates set C = NULL.

Value

A list containing point estimates of the unconstrained model parameters.
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