Package 'mr.pivw'

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Type Package

Title Penalized Inverse-Variance Weighted Estimator for Mendelian
Randomization

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Description The penalized inverse-variance weighted (pIVW) estimator is a Mendelian randomization method for estimating the causal effect of an exposure variable on an outcome of interest based on summary-level GWAS data. The pIVW estimator accounts for weak instruments and balanced horizontal pleiotropy simultaneously. See Xu S., Wang P., Fung W.K. and Liu Z. (2022) <doi:10.1111/biom.13732>.

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R topics documented:

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BF_distr	*Generate bootstrap samples for the bootstrapping Fieller's confidence interval*

Description

This function is used to generate bootstrap samples for the bootstrapping Fieller's confidence interval.

Usage

```
BF_distr(data,beta_hat,tau2,lambda,n_boot=1000,seed_boot=1)
```

Arguments

data	A matrix or data frame consists of four columns: the 1st (2nd) column contains the estimated genetic effects on the outcome (exposure); the 3rd (4th) column contains the estimated standard errors of the estimated genetic effects on the outcome (exposure).
beta_hat	The estimated causal effect.
tau2	The estimated variance of the horizontal pleiotropy.
lambda	The penalty parameter in the pIVW estimator. The penalty parameter plays a role in the bias-variance trade-off of the estimator.
n_boot	The sample size of the bootstrap samples. By default, n_boot=1000.
seed_boot	The seed for random sampling in the bootstrap method. By default, seed_boot=1.

Value

z_b	A vector containing the bootstrap samples for the bootstrapping Fieller's confidence interval.

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example	*Data example*

Description

A matrix contains four columns: the 1st (2nd) column contains the estimated genetic effects on the outcome (exposure); the 3rd (4th) column contains the estimated standard errors of the estimated genetic effects on the outcome (exposure).

| mr.pivw | *The penalized inverse-variance weighted estimator for Mendelian randomization* |

Description

The penalized inverse-variance weighted (pIVW) estimator is a Mendelian randomization method for estimating the causal effect of an exposure variable on an outcome of interest based on summary-level GWAS data. The pIVW estimator accounts for weak instruments and balanced horizontal pleiotropy simultaneously.

Usage

```
mr.pivw(data,lambda=1,plei=TRUE,sel.pval=NULL,delta=0,Boot.Fieller=TRUE,sig=0.05)
```

Arguments

data	A matrix or data frame consists of four columns. The 1st and 2nd columns contain the SNP effects on the outcome and the exposure, respectively. The 3rd and 4th columns contain the standard errors of the SNP effects on the outcome and the exposure, respectively.
lambda	The penalty parameter in the pIVW estimator. The penalty parameter plays a role in the bias-variance trade-off of the estimator. It is recommended to choose lambda=1 to achieve smallest bias and valid inference. By default, lambda=1.
plei	If plei=TRUE, then the horizontal pleiotropy will be taken into account in the pIVW estimator. By default, plei=TRUE.
sel.pval	A vector containing the P values of the SNP effects on the exposure, which will be used for the IV selection. "sel.pval" should be provided when "delta" is not zero.
delta	The z-score threshold for IV selection. By default, delta=0 (i.e., no IV selection will be conducted).
Boot.Fieller	If Boot.Fieller=TRUE, then the P value and the confidence interval of the causal effect based on the bootstrapping Fieller method will be calculated. By default, Boot.Fieller=TRUE.
sig	The 100(1-sig)% confidence interval of the causal effect is calculated. By default, sig=0.05.

Value

beta.hat	The estimated causal effect of the exposure on the outcome
beta.se	The estimated standard error of beta.hat
pval (Normal)	The P value for testing whether the causal effect is zero, which is based on the normal approximation.
CI (Normal)	The confidence interval of the causal effect based on the normal approximation.

pval (Bootstrap Fieller)

>The P value for testing whether the causal effect is zero, which is based on the bootstrapping Fieller method.

CI (Bootstrap Fieller)

>The confidence interval of the causal effect based on the bootstrapping Fieller method.

tau2

>The variance of the horizontal pleiotropy. tau2 is calculated by using all IVs in the data before conducting the IV selection.

eta

>The estimated effective sample size. It is recommended to be greater than 5 for pIVW to achieve reliable asymptotic properties.

References

Xu S., Wang P., Fung W.K. and Liu Z. (2022). A Novel Penalized Inverse-Variance Weighted Estimator for Mendelian Randomization with Applications to COVID-19 Outcomes. Biometrics. <doi:10.1111/biom.13732>

Examples

```
mr.pivw(data=example)
```

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