Package: FLOWMR (via r-universe)

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Type Package

Title An R Package for Mendelian Randomization in the mediation setting

Version 1.0

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Description A Bayesian framework for Mendelian Randomization in the mediation setting.

License What license is it under?

Imports Rcpp (>= 1.0.9), coda, doParallel, foreach, ggplot2, stats, magic

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 7.3.2

Encoding UTF-8

Suggests knitr, rmarkdown

VignetteBuilder knitr

Repository https://mrcieu.r-universe.dev

RemoteUrl https://github.com/ZixuanWu1/FLOW-MR

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Contents

`FLOWMR-package` *An R Package for Mendelian Randomization in the mediation setting*

Description

A Bayesian framework for Mendelian Randomization in the mediation setting.

Details

The DESCRIPTION file: This package was not yet installed at build time.

Index: This package was not yet installed at build time.
~~ An overview of how to use the package, including the most important functions ~~

Author(s)

Zixuan Wu [aut, cre], Ethan Lewis [aut], Qingyuan Zhao [aut], Jingshu Wang [aut]

Maintainer: Zixuan Wu <zixuanwu@uchicago.edu>

References

~~ Literature or other references for background information ~~

Examples

```
# simple examples of the most important functions ~~
```

`BayesMediation` *BayesMediation*

Description

Bayes approach for MR Mediation model.

Usage

```
BayesMediation(
  Gamma_hat,
  Sd_hat,
  init = "Random",
  iter = 6000,
  warmup = 3000,
  second = F,
  inv = FALSE,
```

```
  cor = NULL,
  Raw = T,
  total = F,
  indirect = F
)
```

Arguments

Gamma_hat	The estimated exposure and outcome effects gamma_hat
Sd_hat	The standarded errors of gamma_hat
init	Starting value for gibbs sampler. Either "Random" or "EM"
iter	The number of iterations for gibbs sampler
warmup	The length of warm-up periods
second	Whether to run the second stage. Default is False.
inv	When inv = False, we are estiming B in Gamma = (I + B) alpha; inv = True, we are estimating B in Gamma = B Gamma + alpha.
cor	The correlation matrix of noise.
Raw	Whether to include the unprocessed raw outputs. Default is F
total	Whether to include the total effects. Default is F
indirect	Whether to include the indirect effects. Default is F.

Value

A list with elements

`summary_first`

`summary_second`
`total_effect_first`

computed by first stage (included if total = T)

`total_effect_second`

computed by second stage (included if total = T and second = T)

`indirect_effect_first`

computed by first stage (included if indirect = T)

`indirect_effect_second`

computed by second stage (included if indirect = T and second = T)

`raw_first`

`raw_second`

`gibbs_sampler` *Perform Gibbs sampling for mediation MR without correlation*

Description

Model is that Y = (I+B)A + noise

Usage

```
gibbs_sampler(
  Y,
  Sd_hat,
  N,
  B,
  sigma,
  sigma1,
  sigma0,
  p,
  A,
  Z,
  alpha_B,
  beta_B,
  alpha_0,
  alpha_1,
  beta_0,
  beta_1,
  a,
  b
)
```

Arguments

`Y`	KxP arma::matrix of GWAS marginal associations
`Sd_hat`	KxP arma::matrix of GWAS std errors
`N`	number of samples to obtain
`B`	initial value of B arma::matrix
`sigma`	Initial value of prior std deviation for values of B
`sigma1`	K-arma::vector of Initial values of prior slab SDs for each trait's pleiotropy
`sigma0`	K-arma::vector of Initial values of prior splike SDs for each trait's pleiotropy
`p`	K-arma::vector of initial values for p, which is slab probability for mixture
`A`	KxP arma::matrix of initial values for A (ignored)
`Z`	KxP arma::matrix of initial values for Z (ignored), which is latent varaible indicating if A[i,j] comes from slab
`alpha_B`	Shape parameter of InvGamma prior for sigma (for B)

beta_B	Scale parameter of InvGamma prior for sigma (for B)
alpha_0	K-arma::vector Shape parameter of InvGamma prior for sigma0 (Spike)
alpha_1	K-arma::vector Shape parameter of InvGamma prior for sigma0 (Slab)
beta_0	K-arma::vector Scale parameter of InvGamma prior for sigma0 (Spike)
beta_1	K-arma::vector Scale parameter of InvGamma prior for sigma0 (Slab)
a	K-arma::vector First parameter of beta prior for p
b	K-arma::vector Second parameter of beta prior for p

`gibbs_sampler_with_corr` *Perform Gibbs sampling for mediation MR with correlation*

Description

Model is that Y = (I+B)A + noise

Usage

```
gibbs_sampler_with_corr(
  Y,
  Sd_hat,
  trait_corr,
  N,
  B,
  sigma,
  sigma1,
  sigma0,
  p,
  A,
  Z,
  alpha_B,
  beta_B,
  alpha_0,
  alpha_1,
  beta_0,
  beta_1,
  a,
  b,
  Lambda3,
  Lambda_inv3
)
```

Arguments

Y	KxP arma::matrix of GWAS marginal associations
Sd_hat	KxP arma::matrix of GWAS std errors
trait_corr	KxK arma::matrix of correlation of noises.
N	number of samples to obtain
B	initial value of B arma::matrix
sigma	Initial value of prior std deviation for values of B
sigma1	K-arma::vector of Initial values of prior slab SDs for each trait's pleiotropy
sigma0	K-arma::vector of Initial values of prior splike SDs for each trait's pleiotropy
p	K-arma::vector of initial values for p, which is slab probability for mixture
A	KxP arma::matrix of initial values for A (ignored)
Z	KxP arma::matrix of initial values for Z (ignored), which is latent varaible indicating if A[i,j] comes from slab
alpha_B	Shape parameter of InvGamma prior for sigma (for B)
beta_B	Scale parameter of InvGamma prior for sigma (for B)
alpha_0	K-arma::vector Shape parameter of InvGamma prior for sigma0 (Spike)
alpha_1	K-arma::vector Shape parameter of InvGamma prior for sigma0 (Slab)
beta_0	K-arma::vector Scale parameter of InvGamma prior for sigma0 (Spike)
beta_1	K-arma::vector Scale parameter of InvGamma prior for sigma0 (Slab)
a	K-arma::vector First parameter of beta prior for p
b	K-arma::vector Second parameter of beta prior for p
Lambda3	Precomputed covariance matrix
Lambda_inv3	Precomputed inverse covariance matrix

`gibbs_wrapper` *Gibbs sampler*

Description

Given the observed effect and standard error, run gibbs sampler to draw samples from the posterior density

Usage

```
gibbs_wrapper(
  N,
  warmup,
  chains = 4,
  Gamma_hat,
  Sd_hat,
```

```
  sigma,
  sigma_1,
  sigma_0,
  p,
  parallel = TRUE,
  init = "Random",
  ratio = 10,
  cor_mat = NULL,
  Lambda = NULL,
  Lambda_inv = NULL
)
```

Arguments

N	Number of total iterations
warmup	Number of warm-up iterations.
chains	Number of Chains.
Gamma_hat	The observed effects
Sd_hat	The standard deviation of Gamma_hat
sigma	The prior mean for sigma
sigma_1	The prior mean for sigma_1
sigma_0	The prior mean for sigma_0
p	The prior mean for p
parallel	Indicating whether to parallelly run all the chains. Default is True.
init	Method of Initialization. Must be one of "EM" or "Random". Default is "Random"
ratio	The ratio of initial sigma1 and sigma0 when the initialization method is "Random". Default is 10.
cor_mat	The correlation matrix for noise. Default is null (no correlation)
Lambda	The block diagonal matrix such that each block is the covariance matrix of the noise for a SNP. Default is NULL (not provided)
Lambda_inv	The block diagonal matrix such that each block is the inverse of covariance matrix of the noise for a SNP. Default is NULL (not provided).

Value

A list of which the elements are outputs from each chain. Each of these outputs is a list with attributes

B

p

sigma1

sigma0

pi

sigma

indirect_effect *Indirrect effedt*

Description

Estimate the indirrect effect of an exposure on the outcome

Usage

```
indirect_effect(
  results,
  K,
  warmup = 3000,
  path = NULL,
  quantiles = c(0.025, 0.5, 0.975)
)
```

Arguments

results	results from gibbs_wrapper
K	number of phenotypes
quantiles	A vector of quantiles of interests
warump	The length of warmup period. Default is 3000

Value

A matrix of indirect effect and its quantiles.

summary_gibbs *Produce a summary table of the output from gibbs_wrapper.*

Description

Produce a summary table of the output from gibbs_wrapper.

Usage

```
summary_gibbs(result, pars, K, T = 1000, inv = FALSE)
```

Arguments

result	The output of gibbs_wrapper or gibbs_wrapper_cor
pars	A vector of parameters to be included in the summary table
K	The number of mediation layers
T	The warmup period. Default is 1000.
inv	When inv is TRUE, the function shows summary statistics for B in Gamma = B Gamma + alpha, otherwise it shows summary statistics for B in Gamma = (I + B) alpha. Default is False

Value

A table where each row corresponds to a parameter. It has columns:

mean

variance

sd

2.5%

50%

97.5%

ESS

R_hat

of convergence

---

total_effect *Total effect*

Description

Estimate the total effect of an exposure on the outcome

Usage

```
total_effect(results, K, warmup = 3000)
```

Arguments

results	results from gibbs_wrapper
K	number of phenotypes
warump	The length of warmup period. Default is 3000

Value

A matrix of total effect and its quantiles.

traceplot *Produce traceplot for the specified parameter*

Description

Produce traceplot for the specified parameter

Usage

```
traceplot(results, par, ind, chains = -1, ylim = NA, T = 1000)
```

Arguments

results	The output of gibbs_wrapper.
ind	The index of the parameter. For "B" it is a two-vector. For "sigma1", "sigma0" and "pi" it is a single number. For "sigma" ind is ignored.
chains	The indices of chains to be included in the plot. Default is -1, which uses all the chains.
ylim	The range of y-axis in the final plot
T	The number of warmup period.
pars	A parameter to be ploted. Must be one of "B", "sigma", "sigma1", "sigma0" and "pi".

Value

A traceplot of a scalar parameter after warmup-period

zero.centered.em *Perform EM Algorithm on Pleiotropy*

Description

Fit a two-component zero-mean Gaussian mixture on a sequence of observed values

Usage

```
zero.centered.em(
  values,
  std.errors,
  initial_slab_prob = 0.05,
  initial_sigma1_squared = 0.1,
  initial_sigma2_squared = 1e-04,
  iters = 100,
  optimizer = "Brent",
  show_outputs = FALSE
)
```

Arguments

values	A vector of observations.
initial_slab_prob	The initial value for the proportion of slab (the Gaussian component with higher variance). Default is .05.
initial_sigma1_squared	The initial value for the variance of the slab component. Default is .1.
initial_sigma2_squared	The initial value for the variance of the spike component. Default is .0001
iters	The number of iterations of EM algorithm. Default is 100
optimizer	The method used in Maximization Step. Must be one of "Brent", "Nelder-Mead" and "L-BFGS-B". Default is "Brent".
show_outputs	Whether to included a plot of the fitted density and the smoothed data density. Default is FALSE.
std.error	The standard error of noise of observations.

Value

A list of elements

S1

S2

Pi

Index