Package ‘bama’

September 30, 2019

Title High Dimensional Bayesian Mediation Analysis

Version 0.9.1

URL https://github.com/umich-cphds/bama

BugReports https://github.com/umich-cphds/bama/issues

Description Perform mediation analysis in the presence of high-dimensional mediators based on the potential outcome framework. Bayesian Mediation Analysis (BAMA), developed by Song et al (2018) <doi:10.1101/467399>, relies on two Bayesian sparse linear mixed models to simultaneously analyze a relatively large number of mediators for a continuous exposure and outcome assuming a small number of mediators are truly active. This sparsity assumption also allows the extension of univariate mediator analysis by casting the identification of active mediators as a variable selection problem and applying Bayesian methods with continuous shrinkage priors on the effects.

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

LinkingTo Rcpp, RcppArmadillo

Imports Rcpp

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation yes

Author Alexander Rix [aut, cre], Yanyi Song [aut]

Maintainer Alexander Rix <alexrix@umich.edu>

Repository CRAN

Date/Publication 2019-09-30 11:30:05 UTC
Description

bama is a Bayesian inference method that uses continuous shrinkage priors for high-dimensional Bayesian mediation analysis, developed by Song et al (2018). bama provides estimates for the regression coefficients as well as the posterior inclusion probability for ranking mediators.

Usage

bama(Y, A, M, C, beta.m, alpha.a, burnin, ndraws)

Arguments

Y numeric outcome vector
A numeric exposure vector
M numeric matrix of mediators of Y and A
C numeric matrix of extra covariates to include
beta.m numeric vector of initial beta.m in the outcome model
alpha.a numeric vector of initial alpha.a in the mediator model
burnin number of iterations to run the MCMC before sampling
ndraws number of draws to take from MCMC after the burnin period

Details

bama uses two regression models for the two conditional relationships, Y|A, M, C and M|A, C. For the outcome model, bama uses

\[ Y = \beta_M M + A \beta_A + C \beta_C + \epsilon_Y \]

For the mediator model, bama uses the model

\[ M = \alpha_M A + C \alpha_C + \epsilon_M \]

For high dimensional tractability, bama employs continuous Bayesian shrinkage priors to select mediators and makes the two following assumptions: First, it assumes that all the potential mediators contribute small effects in mediating the exposure-outcome relationship. Second, it assumes that only a small proportion of mediators exhibit large effects ("active" mediators). bama uses a Metropolis-Hastings within Gibbs MCMC to generate posterior samples from the model.
Value

*bama* returns an object of type "bama" with 11 elements each of length *ndraws*, sampled from the burned in MCMC:

**beta.m** Outcome model mediator coefficients

**r1** Whether or not each beta.m belongs to the larger normal component (1) or smaller normal component (0)

**alpha.a** Mediator model exposure coefficients

**r3** Whether or not each alpha.a belongs to the larger normal component (1) or smaller normal component (0)

**beta.a** beta.a coefficient

**pi.m** Proportion of non zero beta.m coefficients

**pi.a** Proportion of non zero alpha.a coefficients

**sigma.m0** standard deviation of the smaller normal component for mediator-outcome coefficients (beta.m)

**sigma.m1** standard deviation of the larger normal component for mediator-outcome coefficients (beta.m)

**sigma.ma0** Standard deviation of the smaller normal component for exposure-mediator coefficients (alpha.a)

**sigma.ma1** Standard deviation of the larger normal component for exposure-mediator coefficients (alpha.a)

Author(s)

Alexander Rix

References


Examples

```r
library(bama)

Y <- bama.data$y
A <- bama.data$a

# grab the mediators from the example data.frame
M <- as.matrix(bama.data[, paste0("m", 1:100)], nrow(bama.data))

# We just include the intercept term in this example as we have no covariates
C <- matrix(1, 1000, 1)
beta.m <- rep(0, 100)
alpha.a <- rep(0, 100)

set.seed(12345)
```
out <- bama(Y, A, M, C, beta.m, alpha.a, burnin = 1000, ndraws = 100)

# The package includes a function to summarise output from 'bama'
summary <- summary(out)
head(summary)

bama.data  
Synthetic example data for bama

Description
Synthetic example data for bama

Usage
bama.data

Format
A data.frame with 1000 observations on 102 variables:
y Numeric response variable.
a Numeric exposure variable.
m[1-100 ] Numeric mediator variables

print.bama  
Printing bama objects

Description
Print a bama object.

Usage

## S3 method for class 'bama'
print(x, ...)

Arguments
x             An object of class 'bama'.
...           Additional arguments to pass to print.data.frame or summary.bama
**Summary**

`summary.bama` summarizes the 'beta.m' estimates from `bama` and generates an overall estimate, credible interval, and posterior inclusion probability.

**Usage**

```r
## S3 method for class 'bama'
summary(object, rank = F, ci = c(0.025, 0.975), ...)
```

**Arguments**

- **object**: An object of class "bama".
- **rank**: Whether or not to rank the output by posterior inclusion probability. Default is TRUE.
- **ci**: The credible interval to calculate. `ci` should be a length 2 numeric vector specifying the upper and lower bounds of the CI. By default, `ci = c(0.025, 0.975)`.
- **...**: Additional optional arguments to `summary`.

**Value**

A data.frame with 4 elements. The beta.m estimates, the estimates’ credible interval (which by default is 95%), and the posterior inclusion probability (pip) of each 'beta.m'.
Index

*Topic datasets
  bama.data, 4

bama, 2
bama.data, 4
print.bama, 4
summary.bama, 5