**Package ‘BMASEM’**

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**Type** Package

**Title** Bayesian Model Averaging for Structural Equation Models

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**Description** Bayesian Model Averaging Over Directed Acyclic Graphs for Structural Equation Models

**Depends** R ( >= 3.2.0), lavaan

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R topics documented:

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| BMASEM | *Bayesian Model Averaging for Structural Equation Models* |

**Description**

BMASEM expands the work of Madigan and his colleagues (Madigan & Raftery, 1994; Raftery, Madigan, & Hoeting, 1997) by considering a structural equation model as a special case of a directed acyclic graph (Pearl, 2009). BMASEM searches the model space for submodels and obtains a weighted average of the submodels using posterior model probabilities.

**Usage**

BMASEM (from.vars, to.vars, data, OR=20, method="downup", start.link=NA, …)

**Arguments**

from.vars the vector of names of predicting variables in links of the full path diagram. The first variable in the from.vars and the first variable in the to.vars compose a link in the full path diagram. The order of variables in the from.vars and the to.vars should be matched in links in the full path diagram.

to.vars the vector of names of predicted variables in links of the full path diagram.

data a data frame containing the variables in the BAMSEM model.

OR a number specifying the maximum ratio for excluding models in Occam's window.

method a sequence of algorithms for searching submodels, "downup".

start.link a set of links for the starting model. The set is a vector of values of 1 or 0. 1 means the link, which is composed by the corresponding variables in the from.vars and to.vars exists in the starting model. 0 means the link, which is composed by the corresponding variables in the from.vars and to.vars does not exist in the starting model. If this is NA, a starting model is randomly selected.

… further arguments passed to the method

**Value**

BMASEM returns an object of class BMASEM.

The function summary is used to print a summary of the results. The function predict is used to predict the final endogenous variable resulting from a BMASEM from given data.

An object of class BMASEM is a list of containing at least the following components:

parameters labels identifying parameters in the path diagram.

namesfrom the vector of names of predicting variables in links of the path diagram.

namesto the vector of names of predicted variables in links of the path diagram.

method a sequence of algorithms for searching submodels, "downup".

bic values of BIC for the models

postmean the posterior mean of each coefficient (from model averaging)

postsd the posterior standard deviation of each coefficient (from model averaging)

porbne0 the posterior probability that each variable is non-zero (in percent)

postprob the posterior probabilities of the models selected

model labels of the sequence of selected models

lm.df the residual degrees of freedom from the linear model of the reduced form of the path model.

lm.mse the mean squared of residuals from the linear model of the reduced form of the path model.

lm.inv the inverse matrix of predictor variables in the linear model of the reduced form of the path model.

**References**

Kaplan, D., & **Lee, C**. (2015). Bayesian Model Averaging Over Directed Acyclic Graphs With Implications for the Predictive Performance of Structural Equation Models. Structural Equation Modeling. doi: 10.1080/10705511.2015. 1092088.

Madigan, D., & Raftery, A. E. (1994). Model selection and accounting for model uncertainly in graphical models using Occam’s window. Journal of the American Statistical Association, 89, 1535–1546.

Pearl, J. (2009). Causality: Models, reasoning, and inference (2nd ed.). Cambridge, UK: Cambridge University Press.

Raftery, A. E., Madigan, D., & Hoeting, J. A. (1997). Bayesian model averaging for linear regression models. Journal of the American Statistical Association, 92, 179–191.

**Examples**

data(train)

from.vars <- c("x1","x1","x2","x2","y1")

to.vars <- c("y1","y2","y1","y2","y2")

start.link <- c(1, 0, 0, 1, 1)

bmasem <- BMASEM(from.vars, to.vars, data=train, start.link=start.link)

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| predict.BMASEM | *Predict function for BMASEM* |

**Description**

This function predicts the response resulting from a BMASEM from given data.

**Usage**

## S3 method for class ‘BMASEM’

predict(object, newdata, level = .90, bma.model = 0, …)

**Arguments**

object object of type ‘BMASEM’

newdata a data frame containing observations on variables from which the predict variables are to be selected or constructed from a formula.

level a predictive interval

bma.model a selected model for prediction. 0 for the BMASEM (averaged coefficients) and 1 for the Model1 (the best model’s coefficients)

… other parameters to be passed to summary.default

**Value**

The predicted values and the upper and lower credible interval for each observation in newdata.

**Examples**

data(train)

from.vars <- c("x1","x1","x2","x2","y1")

to.vars <- c("y1","y2","y1","y2","y2")

start.link <- c(1, 0, 0, 1, 1)

bmasem <- BMASEM(from.vars, to.vars, data=train, start.link=start.link)

data(test)

pred.y <- predict(bmasem, test)

pred.y$fit

pred.y$lwr

pred.y$upr

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| --- | --- |
| summary.BMASEM | *Summaries of the BMASEM object* |

**Description**

Summary methods for the BMASEM object.

**Usage**

## S3 method for class ‘BMASEM’

summary(object, n.models=10, …)

**Arguments**

object object of type ‘BMASEM’

n.models optional number specifying the number of models to display in summary

… other parameters to be passed to summary.default

**Examples**

data(train)

from.vars <- c("x1","x1","x2","x2","y1")

to.vars <- c("y1","y2","y1","y2","y2")

start.link <- c(1, 0, 0, 1, 1)

bmasem <- BMASEM(from.vars, to.vars, data=train, start.link=start.link)

summary(bmasem)

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| --- | --- |
| test | *Simulated data as a predictive testing set* |

**Description**

The data set (test) is generated data as a predictive testing set for BMASEM using the Mplus software. This data set is used to predict y2 using the fitted model based on the data of train. Thus, the test is generated in the same ways as the train is generated. The test has 200 rows and 4 columns (y1, y2, x1, and x2). The y1 and y2 are endogenous variables while the x1 and x2 are exogenous variables. The y2 is the final endogenous. The x1 and x2 are from normal distribution with mean of zero and variance of 1. Both x1 and x2 affect y1 and y2: y1 = x1 +2x2 + tau1; and y2 = 2x1 + x2 + 0.75y1 + tau2, where tau1 and tau are from normal distribution of mean of -1 and zero and variance of 1 and 1.5, respectively.

**Usage**

data(test)

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| --- | --- |
| train | Simulated data as a model-averaging set |

**Description**

The data set (train) is generated data as a model-averaging set for BMASEM using the Mplus software. The train has 200 rows and 4 columns (y1, y2, x1, and x2). The y1 and y2 are endogenous variables while the x1 and x2 are exogenous variables. The y2 is the final endogenous. The x1 and x2 are from normal distribution with mean of zero and variance of 1. Both x1 and x2 affect y1 and y2: y1 = x1 +2x2 + tau1; and y2 = 2x1 + x2 + 0.75y1 + tau2, where tau1 and tau are from normal distribution of mean of -1 and zero and variance of 1 and 1.5, respectively.

**Usage**

data(train)