Package 'FourWayHMM'

November 30, 2021

Title Parsimonious Hidden Markov Models for Four-Way Data

Version 1.0.0

Description Implements parsimonious hidden Markov models for four-way data via expectation-conditional maximization algorithm, as described in Tomarchio et al. (2020) <arXiv:2107.04330>. The matrix-variate normal distribution is used as emission distribution. For each hidden state, parsimony is reached via the eigen-decomposition of the covariance matrices of the emission distribution. This produces a family of 98 parsimonious hidden Markov models.

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Encoding UTF-8

LazyData true

RoxygenNote 7.1.1

Imports withr, snow, doSNOW, foreach, mclust, tensor, tidyr, data.table, LaplacesDemon

Depends R (>= 2.10)

NeedsCompilation no

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Repository CRAN

Date/Publication 2021-11-30 21:20:02 UTC

R topics documented:

`HMM.fit` *Fitting for parsimonious hidden Markov models for four-way data*

Description

Fits, by using an ECM algorithm, parsimonious hidden Markov models to the given four-way data. Parallel computing is implemented and highly recommended for a faster model fitting. The Bayesian information criterion (BIC) is used to select the best fitting model.

Usage

```
HMM.fit(
  X,
  k = 1:3,
  init.par = NULL,
  mod.row = "all",
  mod.col = "all",
  ncores = 1,
  verbose = FALSE,
  ret.all = FALSE
)
```

Arguments

`X`	An array of dimension `p` x `r` x `n` x `t`, where `p` is the number of variables in the rows of each data matrix, `r` is the number of variables in the columns of each data matrix, `n` is the number of data observations and `t` is the number of times.
`k`	An integer or a vector indicating the number of states of the models.
`init.par`	The initial values for starting the algorithms, as produced by the `HMM.init()` function.
`mod.row`	A character vector indicating the parsimonious structure of the row covariance matrix. Possible values are: "EII", "VII", "EEI", "VEI", "EVI", "VVI", "EEE", "VEE", "EVE", "EEV", "VVE", "VEV", "EVV", "VVV" or "all". When "all" is used, all of the 14 row parsimonious structures are considered.
`mod.col`	A character vector indicating the parsimonious structure of the column covariance matrix. Possible values are: "II", "EI", "VI", "EE", "VE", "EV", "VV", or "all". When "all" is used, all of the 7 column parsimonious structures are considered.
`ncores`	A positive integer indicating the number of cores used for running in parallel.
`verbose`	A logical indicating whether the running output should be displayed.
`ret.all`	A logical indicating whether to report the results of all the models or only those of the best model according to the BIC.

Value

A list with the following elements:

all.models	The results related to the all the fitted models (only when ret.all = TRUE).
BicWin	The best fitting model according to the BIC.
Summary	A quick table showing summary results for the best fitting model according to the BIC.
c.time	Provides information on the computational times required to fit all the models for each state.

Examples

```
data(simX)

init <- HMM.init(X = simX, k = 2, nstartR = 1)
res <- HMM.fit(X = simX, k = 2, init.par = init, mod.row = "VII", mod.col = "EE")
```

HMM.init *Initialization for the ECM algorithm*

Description

Runs the initialization of the ECM algorithm used for fitting the parsimonious hidden Markov models. Parallel computing is implemented and highly recommended for a faster calculation.

Usage

```
HMM.init(X, k = 1:3, nstartR = 100, ncores = 1, verbose = FALSE)
```

Arguments

X	An array of dimension p x r x n x t, where p is the number of variables in the rows of each data matrix, r is the number of variables in the columns of each data matrix, n is the number of data observations and t is the number of times.
k	An integer or a vector indicating the number of states of the models.
nstartR	An integer specifying the number of random starts to be considered.
ncores	A positive integer indicating the number of cores used for running in parallel.
verbose	A logical indicating whether the running output should be displayed.

Value

init	A list of objects to be used by the HMM.fit() function.

Examples

```
data(simX)

init <- HMM.init(X = simX, k = 2, nstartR = 1)
```

simX *Simulated Data*

Description

A simulated four-way dataset with 2 states and VII - EE covariance structure.

Usage

```
data(simX)
```

Format

A four-way array having `p = 2` variables in the rows, `r = 3` variables in the columns, `n = 50` data observations and `t = 10` times.

Index