Package 'GenMarkov'

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Type Package

Title Multivariate Markov Chains

Version 0.1.0

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Description Provides routines to estimate the Mixture Transition Distribution Model based on Raftery (1985) <http://www.jstor.org/stable/2345788> and Nicolau (2014) <doi:10.1111/sjos.12087> specifications, for multivariate data. Additionally, provides a
function for the estimation of a new model for multivariate non-homogeneous Markov chains. This new specification, Generalized Multivariate Markov Chains (GMMC) was proposed by Carolina Vasconcelos and Bruno Damasio and considers (continuous or discrete) covariates exogenous to the Markov chain.

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Imports alabama (>= 2015.3-1), fastDummies (>= 1.6.3), Hmisc (>= 4.5-0), matrixcalc (>= 1.0-3), maxLik (>= 1.4-8), nnet (>= 7.3-16), stats (>= 4.1.0)

NeedsCompilation no

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Repository CRAN

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R topics documented:

mmcx *Non-homogeneous Multivariate Markov Chains*

Description

Estimates Multivariate Markov Chains that depend on a exogeneous variables. The model is based on the Mixture Transition Distribution model, and considers non-homogeneous Markov Chains, instead of homogeneous Markov Chains as in Raftery (1985).

Usage

```
mmcx(y,x,initial)
```

Arguments

y	Matrix of categorical data sequences.
x	Matrix of covariates (exogeneous variables).
initial	Vector of initial values.

Value

The function returns a list with the parameter estimates, standard-errors, z-statistics, p-values and the value of the log-likelihood function, for each equation.

Author(s)

Carolina Vasconcelos and Bruno Damasio

References

Raftery, A. E. (1985). A Model for High-Order Markov Chains. Journal of the Royal Statistical Society. Series B (Methodological), 47(3), 528-539. http://www.jstor.org/stable/2345788

Ching, W. K., E. S. Fung, and M. K. Ng (2002). A multivariate Markov chain modelfor categorical data sequences and its applications in demand predictions. IMA Journal of Management Mathematics, 13(3), 187-199. doi: 10.1093/imaman/13.3.187

See Also

Optmization is done through auglag.

Examples

```
set.seed(1234)
s1 <- sample(c(1,2), 500, replace=TRUE)
s2 <- sample(c(1,2), 500, replace=TRUE)
x <- rnorm(500)
mmcx(y = cbind(s1,s2), x = cbind(x), initial=c(1,1))
```

multi.mtd *Estimation of Multivariate Markov Chains*

Description

This function estimates the Mixture Distribution Model (Raftery (1985)) for Multivariare Markov Chains. It considers Berchtold (2001) optimization algorithm for the parameters and estimates the probabilities transition matrices as proposed in Ching (2002).

Usage

```
multi.mtd(y, deltaStop = 0.0001, is_constrained = TRUE, delta = 0.1)
```

Arguments

y	Matrix of categorical data sequences.
deltaStop	the delta below which the optimization phases of the parameters stop.
is_constrained	flag indicating wether the function will consider the usual set of constraints (usual set: *TRUE*, new set of constraints: *FALSE*).
delta	the amount of change to increase/decrease in the parameters for each iteration of the optimization algorithm.

Value

The function returns a list with the parameter estimates, standard-errors, z-statistics, p-values and the value of the log-likelihood function, for each equation.

Note

See details of the optimization procedure in Berchtold (2001) <doi: 10.1111/14679892.00231>.

Author(s)

Carolina Vasconcelos and Bruno Damasio

References

Raftery, A. E. (1985). A Model for High-Order Markov Chains. Journal of the Royal Statistical Society. Series B (Methodological), 47(3), 528-539. http://www.jstor.org/stable/2345788

Berchtold, A. (2001). Estimation in the Mixture Transition Distribution Model. Journal of Time Series Analysis, 22(4), 379-397.doi: 10.1111/14679892.00231

Ching, W. K., E. S. Fung, and M. K. Ng (2002). A multivariate Markov chain model for categorical data sequences and its applications in demand predictions. IMA Journal of Management Mathematics, 13(3), 187-199. doi: 10.1093/imaman/13.3.187

Examples

```
set.seed(1234)
s1 <- sample(c(1,2), 500, replace=TRUE)
s2 <- sample(c(1,2), 500, replace=TRUE)
multi.mtd(y = cbind(s1,s2))
```

`multi.mtd_probit` *Mixture Transition Distribution - Probit Model*

Description

Estimation of Multivariate Markov Chains through the proposed model by Nicolau (2014). This model presents two attractive features: it is completely free of constraints, thereby facilitating the estimation procedure, and it is more precise at estimating the transition probabilities of a multivariate or higher-order Markov chain than the Raftery's MTD model.

Usage

```
multi.mtd_probit(y, initial, nummethod='bfgs')
```

Arguments

`y`	Matrix of categorical data sequences
`initial`	Vector of initial values
`nummethod`	Numerical maximisation method, currently either "NR" (for Newton-Raphson), "BFGS" (for Broyden-Fletcher-Goldfarb-Shanno), "BFGSR" (for the BFGS algorithm implemented in R), "BHHH" (for Berndt-Hall-Hall-Hausman), "SANN" (for Simulated ANNealing), "CG" (for Conjugate Gradients), or "NM" (for Nelder-Mead). Lower-case letters (such as "nr" for Newton-Raphson) are allowed. The default method is "BFGS". For more details see `maxLik`.

Value

The function returns a list with the parameter estimates, standard-errors, z-statistics, p-values and the value of the log-likelihood function, for each equation.

Author(s)

Carolina Vasconcelos and Bruno Damasio

References

Nicolau, J. (2014). A new model for multivariate markov chains. Scandinavian Journal of Statistics, 41(4), 1124-1135.doi: 10.1111/sjos.12087

Examples

```
set.seed(1234)
s1 <- sample(c(1,2), 500, replace=TRUE)
s2 <- sample(c(1,2), 500, replace=TRUE)
multi.mtd_probit(y = cbind(s1,s2), initial=c(1,1,1), nummethod='bfgs')
```

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