# Package 'mAr'

February 20, 2015

**Title** Multivariate AutoRegressive analysis

**Version** 1.1-2

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**Description** R functions for multivariate autoregressive analysis

**Depends** MASS

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**License** GPL (>= 2)

**Repository** CRAN

**Date/Publication** 2012-10-29 08:59:08

**NeedsCompilation** no

## R topics documented:



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`mAr.eig` *Eigendecomposition of m-variate AR(p) model*

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### Description

Eigen-decomposition of the estimated matrix of autoregressive coefficients from an m-variate AR(p) model

## Usage

```
mAr.eig(A, C = NULL, ...)
```

## Arguments

| | |
|---|---|
| A | matrix of estimated autoregression coefficients |
| C | noise covariance matrix |
| ... | additional arguments for specific methods |

## Value

A list with components:

| | |
|---|---|
| modes | periods and damping times associated to each eigenmode |
| eigv | m*p m-dimensional eigenvectors |

## Author(s)

S. M. Barbosa

## References

Neumaier, A. and Schneider, T. (2001), Estimation of parameters and eigenmodes of multivariate autoregressive models. ACM Transactions on Mathematical Software, 27, 1, 27-57.

Schneider, T. and Neumaier, A. (2001), A Matlab package fo the estimation of parameters and eigenmodes of multivariate autoregressive models, 27, 1, 58-65.

## Examples

```
data(pinkham)
y=mAr.est(pinkham,2,5)
mAr.eig(y$AHat,y$CHat)
```

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# mAr.est *Estimation of multivariate AR(p) model*

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## Description

Stepwise least-squares estimation of a multivariate AR(p) model based on the algorithm of Neumaier and Schneider (2001).

## Usage

```
mAr.est(x, p, ...)
```

## Arguments

| | |
|---|---|
| x | matrix of multivariate time series |
| p | model order |
| ... | additional arguments for specific methods |

## Details

Fits by stepwise least squares an m-variate AR(p) model given by

$$X[t] = w + A1X[t-1] + ... + ApX[t-p] + e[t]$$

where
X[t]=[X1(t)...Xm(t)]' is a vector of length m
w is a m-length vector of intercept terms
A=[A1 ... Ap] is a mp x m matrix of autoregressive coefficients
e(t) is a m-length uncorrelated noise vector with mean 0 and m x m covariance matrix C

## Value

A list with components:

| | |
|---|---|
| SBC | Schwartz Bayesian Criterion |
| wHat | vector of intercept terms |
| AHat | matrix of estimated autoregression coefficients for the fitted model |
| CHat | noise covariance matrix |
| resid | residuals from the fitted model |

## Author(s)

S. M. Barbosa

## References

Neumaier, A. and Schneider, T. (2001), Estimation of parameters and eigenmodes of multivariate autoregressive models. ACM Transactions on Mathematical Software, 27, 1, 27-57.

Schneider, T. and Neumaier, A. (2001), A Matlab package fo the estimation of parameters and eigenmodes of multivariate autoregressive models, 27, 1, 58-65.

Lutkepohl, H. (1993), Introduction to Multiple Time Series Analysis. Springer-Verlag, Berlin.

## Examples

```
data(pinkham)
y=mAr.est(pinkham,2,5)
```

mAr.pca *Multivariate autoregressive analysis in PCA space*

## Description

Estimation of m-variate AR(p) model in reduced PCA space (for dimensionality reduction) and eigen-decomposition of augmented coefficient matrix

## Usage

```
mAr.pca(x, p, k = dim(x)[2], ...)
```

## Arguments

| | |
|---|---|
| x | matrix of multivariate time series |
| p | model order |
| k | number of principal components to retain |
| ... | additional arguments for specific methods |

## Value

A list with components:

| | |
|---|---|
| p | model order |
| SBC | Schwartz Bayesian Criterion |
| fraction.variance | fraction of variance explained by the retained components |
| resid | residuals from the fitted model |
| eigv | m*p m-dimensional eigenvectors |
| modes | periods and damping times associated to each eigenmode |

## Author(s)

S. M. Barbosa

## References

Neumaier, A. and Schneider, T. (2001), Estimation of parameters and eigenmodes of multivariate autoregressive models. ACM Transactions on Mathematical Software, 27, 1, 27-57.

## See Also

mAr.est

## Examples

```
data(sparrows)
A=mAr.est(sparrows,1)$AHat
mAr.eig(A)$modes
mAr.pca(sparrows,1,k=4)$modes
```

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`mAr.sim` *Simulation from a multivariate AR(p) model*

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## Description

Simulation from an m-variate AR(p) model

## Usage

```
mAr.sim(w, A, C, N, ...)
```

## Arguments

| | |
|---|---|
| `w` | vector of intercept terms |
| `A` | matrix of AR coefficients |
| `C` | noise covariance matrix |
| `N` | length of output time series |
| `...` | additional arguments |

## Details

Simulation from an m-variate AR(p) model given by

$$X[t] = w + A1X[t-1] + ... + ApX[t-p] + e[t]$$

where
X[t]=[X1(t)...Xm(t)]' is a vector of length m
w is a m-length vector of intercept terms
A=[A1 ... Ap] is a m x mp matrix of autoregressive coefficients
e(t) is a m-length uncorrelated noise vector with mean 0 and m x m covariance matrix C

## Value

returns a list containg the N simulated observations for each of the m time series

## Author(s)

S. M. Barbosa

## References

Neumaier, A. and Schneider, T. (2001), Estimation of parameters and eigenmodes of multivariate autoregressive models. ACM Transactions on Mathematical Software, 27, 1, 27-57.

Schneider, T. and Neumaier, A. (2001), A Matlab package fo the estimation of parameters and eigenmodes of multivariate autoregressive models, 27, 1, 58-65.

Lutkepohl, H. (1993), Introduction to Multiple Time Series Analysis. Springer-Verlag, Berlin.

## Examples

```
w=c(0.25,0.1)
C=rbind(c(1,0.5),c(0.5,1.5))
A=rbind(c(0.4,1.2,0.35,-0.3),c(0.3,0.7,-0.4,-0.5))
x=mAr.sim(w,A,C,N=300)
```

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# pinkham *Lydia Pinkham Annual Advertising and Sales data*

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## Description

Annual domestic advertising and sales of Lydia E. Pinkham Medicine Company in thousands of dollars 1907-1960

## Usage

```
data(pinkham)
```

## Format

A data frame with 54 observations on the 2 variables.

## Source

Pankratz, A. (1991) Forecasting With Dynamic Regression Models, Wiley.

## References

Wei, W. (1994) Time series analysis - univariate and multivariate methods

## sparrows *Body measurements of sparrows*

### Description

Body measurements of 48 female sparrows.

### Usage

```
data(sparrows)
```

### Format

A data frame with 48 observations on 5 variables

### Source

Manly, B. F. J. (1994). Multivariate Statistical Methods, second edition, Chapman and Hall.

## waves *Time series of ocean wave height measurements*

### Description

Ocean wave height measurements from an wire wave gauge and an infrared wave gauge

### Usage

```
data(waves)
```

### Format

A data frame with 4096 observations on the following 2 variables.

**wire.gauge** height of ocean waves from wire wave gauge

**ir.gauge** height of ocean waves from infrared wave gauge

### Details

Time series of ocean wave height measurements (sampling = 1/ 30 seconds)

### Source

Applied Physics Laboratory (Andy Jessup)

## References

Jessup, A. T., Melville, W. K., Keller, W. C. (1991). Breaking Waves Affecting Microwave Backscatter: Detection and Verification (1991). Journal of Geophysical Research, 96, C11, 20,547–59.

Percival, D. B. (1993). Spectral Analysis of Univariate and Bivariate Time Series, Chapter 11 of "Statistical Methods for Physical Science," Stanford, J. L. and Vardeman, S. B. (Eds), Academic Press

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