

# Package ‘mAr’

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**Title** Multivariate AutoRegressive analysis

**Version** 1.1-2

**Author** S. M. Barbosa

**Description** R functions for multivariate autoregressive analysis

**Depends** MASS

**Maintainer** S. M. Barbosa <susana.barbosa@fc.up.pt>

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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

$$X[t] = w + A_1X[t - 1] + \dots + A_pX[t - p] + e[t]$$

where

$X[t]=[X_1(t)\dots X_m(t)]'$  is a vector of length m

w is a m-length vector of intercept terms

$A=[A_1 \dots A_p]$  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)
```

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mAr.pca

*Multivariate autoregressive analysis in PCA space*

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## 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

$$X[t] = w + A_1X[t - 1] + \dots + A_pX[t - p] + e[t]$$

where

$X[t]=[X_1(t)\dots X_m(t)]'$  is a vector of length m

w is a m-length vector of intercept terms

$A=[A_1 \dots A_p]$  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 containing 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 for 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

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sparrows	<i>Body measurements of sparrows</i>
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**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.

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waves	<i>Time series of ocean wave height measurements</i>
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**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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