

# The ArDec Package

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**Type** Package

**Title** Time series autoregressive-based decomposition

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**Description** Package ArDec implements autoregressive-based decomposition of a time series based on the constructive approach in West (1997). Particular cases include the extraction of trend and seasonal components. Uncertainty on the resulting components can be derived from sampling of the autoregressive model which is written as a linear regression model and handled on a Bayesian framework.

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ardec

*Time series autoregressive decomposition*


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### Description

Decomposition of a time series into latent subseries from a fitted autoregressive model

### Usage

```
ardec(x, coef, th = 0.95, ...)
```

### Arguments

x	time series
coef	autoregressive parameters of AR(p) model
th	value of damping threshold
...	additional arguments for specific methods

### Details

If an observed time series can be adequately described by an (eventually high order) autoregressive AR(p) process, a constructive result (West, 1997) yields a time series decomposition in terms of latent components following either AR(1) or AR(2) processes depending on the eigenvalues of the state evolution matrix.

Complex eigenvalues  $r \exp(iw)$  correspond to pseudo-periodic oscillations as a damped sine wave with fixed period  $(2\pi/w)$  and damping factor  $r$ . Real eigenvalues correspond to a first order autoregressive process with parameter  $r$ .

For time series with missing observations, using ardec can give unreliable results (in case the autoregressive model for the longest consecutive stretch of non-missing values given by `na.contiguous` is not able to capture successfully the temporal structure of the data). Depending on the application / data, interpolation of the missing observations before applying ardec might be preferable.

### Value

An object of the class "ardec", which is a list with components:

start	start time of the time series
frequency	frequency of the time series
period	periods of latent components
modulus	damping factors of latent components
comps	matrix of latent components

### Author(s)

S. M. Barbosa

## References

- West, M. (1997), Time series decomposition. *Biometrika*, 84, 489-494.
- West, M. and Harrison, P.J. (1997), *Bayesian Forecasting and Dynamic Models*, Springer-Verlag.
- Barbosa, SM, Silva, ME, Fernandes, MJ (2008), Changing seasonality in North Atlantic coastal sea level from the analysis of long tide gauge records. *Tellus*, 60A, 165-177.

## Examples

```
data(tempEng)
coef=ardec.lm(tempEng)$coefficients
decomposition=ardec(tempEng,coef)
```

---

ardec.components     *Function to extract autoregressive components*

---

## Description

Extraction of autoregressive components from object of class "ardec"

## Usage

```
ardec.components(object, th = 0.95, ...)
```

## Arguments

object	object of class "ardec"
th	value of damping threshold
...	additional arguments for specific methods

## Value

A list with components

periodcomps	periodic components
trendcomp	trend component

## Author(s)

S. M. Barbosa

**Examples**

```
data(tempEng)
decomposition=ardec(tempEng,ardec.lm(tempEng)$coefficients)
components=ardec.components(decomposition)
plot(components$trendcomp)
plot(components$periodcomps$comps)
```

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ardec.lm

*Function to fit an autoregressive model as a linear regression*


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**Description**

Function ardec.lm fits an autoregressive model of order  $p$ , AR( $p$ ) to a time series through a linear least squares regression.

Function ardec.lm.bayes provides a sample of autoregressive parameters from the multivariate normal posterior distribution for the coefficients assuming a (non-informative) reference prior.

**Usage**

```
ardec.lm(x, method = "burg", na.action = na.contiguous)
```

```
ardec.lm.bayes(x, method = "burg", na.action = na.contiguous, R, med = TRUE, seed = )
```

**Arguments**

x	time series
method	method used to fit the model ("yule-walker", "burg", "ols", "mle", "yw"); defaults to "burg"
na.action	function to be called to handle missing values; defaults to na.contiguous
R	size of sample to be simulated from posterior
med	logical, indicating if a median vector of autoregressive parameters should be computed from the simulated sample
seed	integer for set.seed

**Value**

For ardec.lm, an object of class "lm".

For ardec.lm.bayes an R $\times$ p matrix containing the samples of autoregressive coefficients as columns (if med=FALSE).

If med=TRUE, ardec.lm.bayes returns a single column matrix containing the median vector of autoregressive parameters.

**Author(s)**

S. M. Barbosa

**See Also**[ar, lm](#)**Examples**

```
data(tempEng)
model=ardec.lm(tempEng)
```

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ardec.sampling      *Auxiliary function*

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**Description**

Auxiliary function: sampling from a linear model posterior distribution assuming a reference (non-informative) prior

**Usage**

```
ardec.sampling(x, fit)
```

**Arguments**

x	time series
fit	object of class "lm" from a linear regression fit

**Value**

ARcoef	vector of autoregressive parameters sampled from the posterior distribution
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**Author(s)**

S. M. Barbosa

**Examples**

```
data(tempEng)
model=ardec.lm(tempEng)
ardec.sampling(tempEng, model)
```

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`tempEng`*Time series of monthly temperature values*

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**Description**

Monthly temperature in Central England from 1723-1970

**Usage**

```
data(tempEng)
```

**Format**

Time-Series [1:2976] from 1723 to 1971

**Source**

Hipel, K. W. and Mcleod, A. (1994) Time Series Modelling of Water Resources and Environmental Systems, Elsevier

**Examples**

```
data(tempEng)
```

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