

# Package ‘FitARMA’

July 2, 2014

**Title** FitARMA: Fit ARMA or ARIMA using fast MLE algorithm

**Version** 1.6

**Date** 2013-09-26

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**Depends** R (>= 2.1.0), FitAR

**Description** Implements fast maximum likelihood algorithm for fitting ARMA time series. Uses S3 methods print, summary, fitted, residuals. Fast exact Gaussian ARMA simulation.

**Classification/ACM** G.3, G.4, I.5.1

**Classification/MSC** 62M10, 91B84

**License** GPL (>= 2)

**URL** <http://www.stats.uwo.ca/faculty/aim>

**NeedsCompilation** yes

**Repository** CRAN

**Date/Publication** 2013-09-27 19:29:04

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FitARMA-package	<i>FitARMA: Fit ARMA or ARIMA using fast MLE algorithm</i>
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## Description

Fit ARMA/ARIMA time series model using fast algorithm. All MLE computations in R. Two estimation functions: 'FitARMA' and 'GetFitARMA' are provided. 'FitARMA' provides more options including an option for exact MLE estimation of the intercept term. 'GetFitARMA' is provided for bootstrapping and simulation experiments. S3 Methods 'print', 'summary', 'coef', 'residuals', 'fitted' provided. Fast exact Gaussian ARMA simulation using C.

## Details

Package:	FitARMA
Type:	Package
Version:	1.4
Date:	2010-12-01
License:	GLP 2.0 or greater
LazyLoad:	yes

FitARMA is the main function.

## Author(s)

A.I. McLeod

## References

A. I. McLeod, Ying Zhang (2007). Faster ARMA maximum likelihood estimation, Computational Statistics & Data Analysis 52(4), URL <http://dx.doi.org/10.1016/j.csda.2007.07.020>

## See Also

[arima](#), [AcfPlot](#)

## Examples

```
data(SeriesA)
#ARIMA(0,1,1) with exact estimation of mean of differenced series
ans<-FitARMA(SeriesA, order=c(0,1,1), MeanMLEQ=TRUE)
```

```

ans
coef(ans)
#ARIMA(0,1,1) with sample-mean estimation of mean of differenced series
ans<-FitARMA(SeriesA, order=c(0,1,1))
ans
coef(ans)
#ARIMA(0,1,1) with mean of differenced series set to zero
#as in 'arima'
ans<-FitARMA(SeriesA, order=c(0,1,1), demean=FALSE)
ans
coef(ans)
# illustrating methods
summary(ans)
resid(ans)
fitted(ans)
ans$racf
#Simulate and fit Gaussian ARMA
z<-SimulateGaussianARMA(0.9, 0.5, 200)
#GetFitARMA is faster than FitARMA.
#Use GetFitARMA for parametric bootstrap and simulation experiments
GetFitARMA(z, p=1, q=1)

```

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coef.FitARMA

*coef method for class FitARMA*


---

### Description

produces table showing parameters, standard errors and Z-ratios

### Usage

```
## S3 method for class 'FitARMA'
coef(object, ...)
```

### Arguments

object	class FitARMA object
...	auxiliary parameters

### Value

matrix with 3 columns

### Author(s)

A.I. McLeod

**See Also**[FitARMA](#)**Examples**

```
data(SeriesA)
out<-FitARMA(SeriesA, c(1,0,1))
coef(out)
```

FitARMA

*Fit ARMA/ARIMA using fast MLE algorithm***Description**

Fits an ARIMA(p,d,q) model using the algorithm given in McLeod and Zhang (2007).

**Usage**

```
FitARMA(z, order = c(0, 0, 0), demean = TRUE, MeanMLEQ = FALSE, pApprox = 30, MaxLag = 30)
```

**Arguments**

z	time series
order	model order, c(p,d,q)
demean	if TRUE, mean parameter included otherwise assumed zero
MeanMLEQ	exact MLE for mean, ignored unless demean=TRUE
pApprox	order of approximation to be used
MaxLag	maximum number of lags for portmanteau test

**Details**

See McLeod and Ying (2007).

**Value**

A list with class name "FitARMA" and components:

loglikelihood	value of the loglikelihood
phiHat	AR coefficients
thetaHat	MA coefficients
sigsqHat	innovation variance estimate
muHat	estimate of the mean
covHat	covariance matrix of the coefficient estimates
racf	residual autocorrelations

LjungBox	table of Ljung-Box portmanteau test statistics
res	innovation residuals, same length as z
fits	fitted values, same length as z
demean	TRUE if mean estimated otherwise assumed zero
IterationCount	number of iterations in mean mle estimation
convergence	value returned by optim – should be 0
MLEMeanQ	TRUE if mle for mean algorithm used
tsp	tsp(z)
call	result from match.call() showing how the function was called
ModelTitle	description of model
DataTitle	returns attr(z,"title")

**Note**

When  $d > 0$  and `demean=TRUE`, the mean of the differenced series is estimated. This corresponds to including a polynomial of degree  $d$ .

When  $d > 0$ , the AIC/BIC are computed for the differenced series and so they are not comparable to the values obtained for models with  $d=0$ .

**Author(s)**

A.I. McLeod, [aimcleod@uwo.ca](mailto:aimcleod@uwo.ca)

**References**

A.I. McLeod and Y. Zhang (2008), Faster ARMA maximum likelihood estimation, *Computational Statistics & Data Analysis*, 52-4, 2166-2176. DOI link: <http://dx.doi.org/10.1016/j.csda.2007.07.020>

**See Also**

[GetFitARMA](#), [print.FitARMA](#), [coef.FitARMA](#), [residuals.FitARMA](#), [fitted.FitARMA](#), [arima](#)

**Examples**

```
data(SeriesA) #in datasets()
out1<-FitARMA(SeriesA, c(1,0,1))
out1
coef(out1)
out2<-FitARMA(SeriesA, c(0,1,1))
out2
coef(out2)
```

---

fitted.FitARMA	<i>fitted method for class FitARMA</i>
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### Description

The fitted values are the observed minus residuals. If there is differencing, the observed values are those corresponding to the differenced time series.

### Usage

```
## S3 method for class 'FitARMA'  
fitted(object, ...)
```

### Arguments

object	class FitARMA object
...	auxiliary parameters

### Value

vector or ts object

### Author(s)

A.I. McLeod

### See Also

[FitARMA](#)

### Examples

```
data(SeriesA)  
out<-FitARMA(SeriesA, c(1,0,1))  
fitted(out)
```

---

`GetFitARMA`*Fit ARMA(p,q) model to mean zero time series.*

---

**Description**

The algorithm of McLeod and Zhang (2007) is used.

**Usage**

```
GetFitARMA(y, p, q, pApprox = 30, init = 0)
```

**Arguments**

<code>y</code>	time series
<code>p</code>	AR order
<code>q</code>	MA order
<code>pApprox</code>	AR approximation
<code>init</code>	initial parameter estimates

**Details**

See McLeod and Zhang (2006).

**Value**

<code>loglikelihood</code>	value of maximized loglikelihood
<code>phiHat</code>	estimated phi parameters
<code>thetaHat</code>	estimated theta parameters
<code>convergence</code>	result from optim
<code>algorithm</code>	indicates "L-BFGS-B" or "Nelder-Mead" according as which algorithm was used in optim

**Author(s)**

A.I. McLeod, aimcleod@uwo.ca

**References**

A.I. McLeod and Y. Zhang (2008), Faster ARMA maximum likelihood estimation, Computational Statistics & Data Analysis, 52-4, 2166-2176. DOI link: <http://dx.doi.org/10.1016/j.csda.2007.07.020>

**See Also**

[arima](#), [FitARMA](#)

**Examples**

```
data(SeriesA)
z<-SeriesA-mean(SeriesA)
GetFitARMA(z, 1, 1)
w<-diff(z, differences=1)
GetFitARMA(w, 0, 1)
```

---

ImpulseCoefficientsARMA

*Impulse coefficients of ARMA*

---

**Description**

The coefficients in the infinite MA expansion of the ARMA model are determined.

**Usage**

```
ImpulseCoefficientsARMA(phi, theta, lag.max)
```

**Arguments**

phi	AR coefficients
theta	MA coefficients
lag.max	lags 0,...,lag.max

**Value**

vector length lag.max+1

**Author(s)**

A.I. McLeod

**Examples**

```
ImpulseCoefficientsARMA(0.9,0.5,20)
```



---

InformationMatrixARMA *Expected large-sample information matrix for ARMA*

---

**Description**

The expected large-sample information matrix per observation for ARMA(p,q) models is computed.

**Usage**

```
InformationMatrixARMA(phi = numeric(0), theta = numeric(0))
```

**Arguments**

phi	AR coefficients
theta	MA coefficients

**Details**

The information matrix is derived by Box and Jenkins (1970).

**Value**

a matrix of order (p+q)

**Author(s)**

A.I. McLeod

**References**

Box and Jenkins (1970). Time Series Analysis: Forecasting and Control.

**See Also**

[FitARMA](#)

**Examples**

```
#The covariance matrix estimates of the parameters phi and theta in an ARMA(1,1)
#with phi=0.9 and theta=0.5 and n=200 is
v<-solve(InformationMatrixARMA(0.9,0.5))/200
v
#and the standard errors are
sqrt(diag(v))
```

---

print.FitARMA	<i>print method for class FitARMA</i>
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---

**Description**

a brief summary is printed out of the fitted model

**Usage**

```
## S3 method for class 'FitARMA'  
print(x, ...)
```

**Arguments**

x	object, class FitARMA
...	optional arguments

**Value**

the result is displayed

**Author(s)**

A.I. McLeod

**See Also**

[FitARMA](#)

**Examples**

```
data(SeriesA)  
FitARMA(SeriesA, c(1,0,1))
```

---

residuals.FitARMA	<i>residuals method for class FitARMA</i>
-------------------	---

---

**Description**

The innovation residuals are obtained.

**Usage**

```
## S3 method for class 'FitARMA'  
residuals(object, ...)
```

**Arguments**

object            class FitARMA object  
 ...              auxiliary parameters

**Value**

vector or ts object

**Author(s)**

A.I. McLeod

**See Also**

[FitARMA](#)

**Examples**

```
data(SeriesA)
out<-FitARMA(SeriesA, c(1,0,1))
resid(out)
```

---

SimulateGaussianARMA    *Simulate Gaussian ARMA model*

---

**Description**

An exact simulation method is used to simulate Gaussian ARMA models.

**Usage**

```
SimulateGaussianARMA(phi, theta, n, InnovationVariance = 1, UseC = TRUE)
```

**Arguments**

phi                AR coefficients  
 theta             MA coefficients  
 n                  length of series  
 InnovationVariance  
                   innovation variable, default is 1  
 UseC              if UseC=TRUE, use C code. Otherwise, use slower R code.

**Details**

The detailed description is given in Hipel and McLeod (1994, 2006).

**Value**

a vector containing the time series

**Author(s)**

A.I. McLeod

**References**

Hipel, K.W. and McLeod, A.I. (2006). Time Series Modelling of Water Resources and Environmental Systems.

**See Also**

[arima.sim](#)

**Examples**

```
z<-SimulateGaussianARMA(0.9, 0.5, 200)
FitARMA(z, c(1,0,1))
```

---

summary.FitARMA

*print method for class FitARMA*

---

**Description**

a summary is printed out of the fitted model

**Usage**

```
## S3 method for class 'FitARMA'
summary(object, ...)
```

**Arguments**

object	object, class FitARMA
...	optional arguments

**Value**

the result is displayed

**Author(s)**

A.I. McLeod

**See Also**[FitARMA](#)**Examples**

```
data(SeriesA)
out<-FitARMA(SeriesA, c(1,0,1))
summary(out)
```

---

**TacvfARMA***Theoretical Autocovariance Function of ARMA*

---

**Description**

The theoretical autocovariance function of an ARMA(p,q) with unit variance is computed. This algorithm has many applications. In this package it is used for the computation of the information matrix, in simulating p initial starting values for AR simulations and in the computation of the exact mle for the mean.

**Usage**

```
TacvfARMA(phi = numeric(0), theta = numeric(0), lag.max = 20)
```

**Arguments**

phi	AR coefficients
theta	MA coefficients
lag.max	computes autocovariances lags 0,1,...,lag.max

**Details**

The algorithm given by McLeod (1975) is used.

The built-in R function ARMAacf could also be used but it is quite complicated and apart from the source code, the precise algorithm used is not described. The only reference given for ARMAacf is the Brockwell and Davis (1991) but this text does not give any detailed exact algorithm for the general case.

Another advantage of TacvfARMA over ARMAacf is that it will be easier for to translate and implement this algorithm in other computing environments such as MatLab etc.

**Value**

vector of length lag.max+1 containing the autocovariances is returned

**Author(s)**

A.I. McLeod

**References**

McLeod, A.I. (1975), Derivation of the theoretical autocorrelation function of autoregressive moving-average time series, *Applied Statistics* 24, 255-256.

**See Also**

[ARMAacf](#), [InformationMatrixARMA](#)

**Examples**

```
#calculate and plot the autocorrelations from an ARMA(1,1) model
# with parameters phi=0.9 and theta=0.5
g<-TacfARMA(0.9,0.5,20)
AcfPlot(g/g[1], LagZeroQ=FALSE)
```

---

tccfAR

*Theoretical cross-covariances of auxiliary AR process in ARMA(p,q)*


---

**Description**

The auxiliary AR processes in the ARMA(p,q) model  $\phi(B)z(t)=\theta(B)a(t)$  are defined by  $\phi(B)u(t)=a(t)$  and  $\theta(B)v(t)=a(t)$ . The upper off-diagonal p-by-q block of the ARMA information matrix is obtained from the cross-covariances of  $u(t)$  and  $v(t)$ . This function obtains these covariances.

**Usage**

```
tccfAR(phi, theta)
```

**Arguments**

phi	AR coefficients in ARMA
theta	MA coefficients in ARMA

**Details**

A set of linear equations which determine the covariances is solved. The algorithm is similar in spirit to that for the autocovariances (McLeod, 1975).

**Value**

vector of cross-covariances

**Author(s)**

A.I. McLeod

**References**

McLeod, A.I. (1975), Derivation of the theoretical autocorrelation function of autoregressive moving-average time series, *Applied Statistics* 24, 255-256.

**See Also**

[InformationMatrixARMA](#)

**Examples**

`tccfAR(0.9,0.5)`

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