Package ‘tswge’

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Type Package

Title Time Series for Data Science

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Description Accompanies the texts Time Series for Data Science with R by Woodward, Sadler and Robertson & Applied Time Series Analysis with R, 2nd edition by Woodward, Gray, and Elliott. It is helpful for data analysis and for time series instruction.

Imports signal,PolynomF,MASS,waveslim,astsa,tidyverse,zoo,plotrix, dplyr, ggplot2, magrittr,nnfor,forecast

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R topics documented:

`tswge-package` *Time Series package for Woodward, Gray, and Elliott text*

Description

These functions and data sets accompany the book "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Author(s)

Wayne Woodward <waynew@smu.edu>

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(wages)
plotts.wge(wages)
```

`aic.ar.wge` *AR Model Identification for AR models*

Description

AR model identification using either AIC, AICC, or BIC and MLE, Burg or YW

Usage

```
aic.ar.wge(x, p = 1:5, type = "aic",method='mle')
```

Arguments

`x`	Realization to be analyzed
`p`	Range of p values to be considered
`type`	Type of model identification criterion: aic, aicc, or bic
`method`	Method used for estimation: MLE, Burg, or YW

Value

`type`	Criterion used: aic (default), aicc, or bic
`method`	Estimation method used: MLE, Burg, or YW
`min_value`	Value of the minimized criterion
`p`	AR order for selected model
`phi`	AR parameter estimates for selected model
`vara`	White noise variance estimate for selected model

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
         aic.ar.wge(fig3.18a,p=1:5,type='aicc',method='burg')
```

`aic.burg.wge` *AR Model Identification using Burg Estimates*

Description

AR model identification using either AIC, AICC, or BIC

Usage

```
aic.burg.wge(x, p = 1:5, type = "aic")
```

Arguments

`x`	Realization to be analyzed
`p`	Range of p values to be considered
`type`	Type of model identification criterion: aic, aicc, or bic

Value

`type`	Criterion used: aic (default), aicc, or bic
`min_value`	Value of the minimized criterion
`p`	AR order for selected model
`phi`	AR parameter estimates for selected model
`vara`	White noise variance estimate for selected model

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
         aic.burg.wge(fig3.18a,p=1:5,type='aicc')
```

`aic.wge` *ARMA Model Identification*

Description

ARMA model identification using either AIC, AICC, or BIC

Usage

```
aic.wge(x, p = 0:5, q = 0:2, type = "aic")
```

Arguments

`x`	Realization to be analyzed
`p`	Range of p values to be considered
`q`	Range of q values to be considered
`type`	Type of model identification criterion: aic, aicc, or bic

Value

`type`	Criterion used: aic (default), aicc, or bic
`min_value`	Value of the minimized criterion
`p`	AR order for selected model
`phi`	AR parameter estimates for selected model
`q`	MA order for selected model
`theta`	MA parameter estimates for selected model
`vara`	White noise variance estimate for selected model

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
        aic.wge(fig3.18a,p=0:5,q=0:1,type='aicc')
```

aic5.ar.wge *Return top 5 AIC, AICC, or BIC picks for AR model fits*

Description

You may select either AIC, AICC, or BIC to use model identification. You can also used ML, Burg, or Yule-Walker estimates. Given a range of values for p and q, the program returns the top 5 candidate models.

Usage

```
aic5.ar.wge(x, p = 0:5, type = "aic",method='mle')
```

Arguments

x	Realization to model
p	Range of AR orders to be considered
type	Either 'aic' (default), 'aicc', or 'bic'
method	Either 'MLE' (default), 'Burg', or 'YW'

Value

A list of p, selected criterion for the top 5 models. The identification type and estimation method are printed on the output.

Note

If some model order combinations give explosively nonstationary models, then the program may stop prematurely. You may need to adjust the range of p and q to avoid these models.

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
          aic5.wge(fig3.18a,p=0:5,q=0:2)
```

`aic5.wge` *Return top 5 AIC, AICC, or BIC picks*

Description

You may select either AIC, AICC, or BIC to use model identification. Given a range of values for p and q, the program returns the top 5 candidate models.

Usage

```
aic5.wge(x, p = 0:5, q = 0:2, type = "aic")
```

Arguments

`x`	Realization to model
`p`	Range of AR orders to be considered
`q`	Range of MA orders to be considered
`type`	Either 'aic' (default, 'aicc', or 'bic')

Value

A list of p,q, and selected criterion for the top 5 models

Note

If some model order combinations give explosively nonstationary models, then the program may stop prematurely. You may need to adjust the range of p and q to avoid these models.

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
          aic5.wge(fig3.18a,p=0:5,q=0:2)
```

`airline` *Classical Airline Passenger Data*

Description

Monthly international airline passengers (in 1000s) from January 1949-December 1960. Series G in Box, Jenkings, and Reinsel text

Usage

```
data("airline")
```

Format

The format is: num [1:144] 112 118 132 129 121 135 148 148 136 119 ...

Source

"Time Series Analysis: Forecasting and Control" by Box, Jenkins, and Reinsel

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(airline)
```

`airlog` *Natural log of airline data*

Description

Natural log of monthly international airline passengers (in 1000s) from January 1949-December 1960. Series G in Box, Jenkings, and Reinsel text

Usage

```
data("airlog")
```

Format

The format is: num [1:144] 4.72 4.77 4.88 4.86 4.8 ...

Source

"Time Series Analysis: Forecasting and Control" by Box, Jenkins, and Reinsel

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(airlog)
```

---

ample.spec.wge *Smoothed Periodogram using Parzen Window*

Description

This function calculates and optionally plots the smoothed periodogram using the Parzen window. The truncation point may be chosen by the user

Usage

```
sample.spec.wge(x, dbcalc = "TRUE", plot = "TRUE")
```

Arguments

`x`	Vector containing the time series realization
`dbcalc`	If dbcalc=TRUE, the calculation is in the log (dB) scale. If FALSE, then non-log calculations are made
`plot`	If PLOT=TRUE then the smoothed spectral estimate is plotted. If FALSE then no plot is created

Value

`freq`	The frequencies at which the smoothed periodogram is calculated
`pzgram`	The smoothed periodogram using the Parzen window

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
sample.spec.wge(rnorm(100))
```

`appy` *Non-perforated appendicitis data shown in Figure 10.8 (solid line) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Annual non-perforated appendicitis rates for years 1970-2005

Usage

```
data("appy")
```

Format

The format is: num [1:36] 14.8 13.7 14.3 14.2 13 ...

Source

Alder, et al. (2010)Archives of Surgery 145, 63-71

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(appy)
```

`artrans.wge` *Perform Ar transformations*

Description

Given a time series in the vector x, and AR coefs phi1 and phi2, for example, artrans.wge computes y(t)=x(t)-phi1X(t-1)-phi2x(t-2), for t=3, ..., n

Usage

```
artrans.wge(x,phi.tr, lag.max=25, plottr = "TRUE")
```

Arguments

`x`	Vector containing original realization
`phi.tr`	Coefficients of the transformation
`lag.max`	Max lag (k) for sample autocorrelations
`plottr`	If plottr=TRUE then plots of the data, transformed data, and sample autocorelations of original and transformed data

Value

Transformed data

Note

For a difference, use phi.tr=1

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott"

Examples

```
data(wtcrude)
difdata=artrans.wge(wtcrude,phi.tr=1,lag.max=30,plottr=TRUE)
```

`backcast.wge` *Calculate backcast residuals*

Description

This function takes either a fitted (or true) model for the realization x and calculates the residuals using the backcasting procedure

Usage

```
backcast.wge(x, phi = 0, theta = 0, n.back = 50)
```

Arguments

`x`	realization
`phi`	AR coefficients
`theta`	MA coefficients
`n.back`	Backcast to X(-n.back)

Value

The n backcast residuals are returned

Author(s)

Wayne Woodward

References

Chapter 7 of Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig6.2nf)
        backcast.wge(fig6.2nf,phi=c(1.2,-.6),theta=.5,n.back=50)
```

---

bat — *Bat echolocation signal shown in Figure 13.11a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Bat echolocation signal of a big brown bat

Usage

```
data("bat")
```

Format

The format is: num [1:381] -0.0049 -0.0083 0.0127 0.0068 -0.0259 0.0059 0.0386 -0.0405 -0.0269 0.0474 ...

Source

Al Feng, Beckman Center of the University of Illinois

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(bat)
```

bitcoin *Daily Bitcoin Prices From May 1, 2020 to April 30, 2021*

Description

This dataset contains the daily price of bitcoin from May 1, 2021 to April 30, 2021. The data was gathered from Yahoo Finance on April 30, 2020 and included missing values on October 9, 12 and 13 of 2020. Yahoo Finance has since filled in the correct values which can be compared with the imputed values described in the book.

Usage

```
data("bitcoin")
```

Format

The format is: num [1:461] 7200.174 6985.470 7344.884 ...

Source

Yahoo Finance

References

"Practical Time Series for Data Scientiests by Woodward, Sadler and Robertson"

Examples

```
data(bitcoin)
```

Bsales *Toy Data Set of Business Sales Data*

Description

100 weeks of sales data with sales, TV advertising budget, Online advertising budget and the abount of a discount if any.

Usage

```
data("Bsales")
```

References

The Time Series Toolkit

Examples

```
data(Bsales)
```

---

bumps16 *16 point bumps signal*

Description

Bumps signal from Donoho and Johnstone(1994) Biometrika 81,425-455

Usage

```
data("bumps16")
```

Format

The format is: num [1:16] 0.1 0.4 5.5 0.2 1.4 0.5 0.3 0.7 0.1 2.5 ...

Source

Donoho and Johnstone(1994) Biometrika 81,425-455

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(bumps16)
```

---

bumps256 *256 point bumps signal*

Description

Bumps signal from Donoho and Johnstone(1994) Biometrika 81,425-455

Usage

```
data("bumps256")
```

Format

The format is: num [1:256] 0.00016 0.00017 0.000182 0.000195 0.000211 ...

Source

Donoho and Johnstone(1994) Biometrika 81,425-455

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(bumps256)
```

`butterworth.wge` *Perform Butterworth Filter*

Description

The user can specify the order of the filter, and whether it is low pass ("low"), high pass ("high"), band stop ("stop"), or band pass ("pass") filter. Requires the CRAN package 'signal'.

Usage

```
butterworth.wge(x, order, type, cutoff,plot=TRUE)
```

Arguments

`x`	Realization to be filtered
`order`	Order of the Butterworth filter
`type`	Either "low", "high", "stop", or "pass" as dicsussed in Descriptions
`cutoff`	For "low" and "high": cutoff is a real number. For "stop" and "band": cutoff is a 2-component vector
`plot`	If plot=TRUE then plots of the original and filtered data are produced.

Value

The filtered data

Note

Requires CRAN package 'signal'

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(wages)
    butterworth.wge(wages,order=4,type="low",cutoff=.05)
```

`cardiac` *Weekly Cardiac Mortality Data*

Description

Weekly cardiac mortality, temperatures, and pollution measures for the years 1970-1978

Usage

```
data("cardiac")
```

Format

ts object consisting of weekly data

Source

Shumway and Stoffer, 1999)

References

"Time Series for Data Sience:Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(cardiac)
```

`cement` *Cement data shown in Figure 3.30a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Quarterly usage of metric tons (in thousands) of Portland cement used from the first quarter of 1973 through the fourth quarter of 1993 in Australia

Usage

```
data("cement")
```

Format

The format is: num [1:84] 1148 1305 1342 1452 1184 ...

Source

Australian Bureau of Statistics

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(cement)
```

`chirp` *Chirp data shown in Figure 12.2a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

256 point linear chirp data

Usage

```
data("chirp")
```

Format

The format is: List of 2 $ x : num [1:256] 1 1 0.98 0.95 0.91 0.86 0.8 0.72 0.63 0.53 ... $ spec: num [1:256] 0.511 0.568 0.733 0.991 1.32 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(chirp)
```

`co.wge` *Cochrane-Orcutt test for trend*

Description

Performs the Cochrane-Orcutt to test for a linear trend in a time series realization.)

Usage

```
co.wge(x,maxp=5)
```

Arguments

`x`	Realization
`maxp`	Maximum AR order allowed for AR model fit to residuals from least squares line

Value

`z`	Residuals from the fitted line
`b0hat`	Estimated y-intercept of the fitted line using the CO method
`b1hat`	Estimated slope of the fitted line using the CO method
`z.order`	Order, p, fit to the residuals
`z.phi`	Coefficients of the AR model fit to the residuals
`pvalue`	P-value of the CO test for the significance of the slope
`tco`	Cochrane-Orcutt test statistic.

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(global.temp)
          co.wge(global.temp,maxp=5)
```

`dfw.2011` *DFW Monthly Temperatures from January 2011 through December 2020*

Description

Monthly average temperatures at Dallas Ft. Worth (in Fahrenheit) from January 2011 through December 2020

Usage

```
data("dfw.2011")
```

Format

ts object consisting of monthly data from January 1900 trough December 2020

Source

https://www.weather.gov/fwd/dmotemp

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(dfw.2011)
```

`dfw.mon` *DFW Monthly Temperatures*

Description

Monthly average temperatures at Dallas Ft. Worth (in Fahrenheit) from January 1900 through December 2020

Usage

```
data("dfw.mon")
```

Format

ts object consisting of monthly data from January 1900 through December 2020

Source

https://www.weather.gov/fwd/dmotemp

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(dfw.mon)
```

`dfw.yr` *DFW Annual Temperatures*

Description

Annual average temperatures at Dallas Ft. Worth (in Fahrenheit) from January 1900 through December 2020

Usage

```
data("dfw.yr")
```

Format

ts object consisting of annual data from 1900 through 2020

Source

https://www.weather.gov/fwd/dmotemp

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(dfw.yr)
```

`doppler` *Doppler Data*

Description

Generated Doppler data

Usage

```
data("doppler")
```

Format

The format is: num [1:2000] -0.00644 -0.01739 -0.02961 -0.04091 -0.04952 ...

Source

Simulated

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(doppler)
```

`doppler2` *Doppler signal in Figure 13.10 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Doppler signal with two time-varying frequencies

Usage

```
data("doppler2")
```

Format

The format is: num [1:200] -0.372 1.246 -1.163 0.261 -0.698 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(doppler2)
```

`dow.annual` *DOW Annual Closing Averages*

Description

DOW Annual closing averages from 1915 through 2020

Usage

```
data("dow.annual")
```

Format

ts object consisting of DOW Annual closing averages from 19155 through 2020

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(dow.annual)
```

`dow.rate` *DOW Daily Rate of Return Data*

Description

DOW daily rate of return data from October 1, 1928 to December 31, 2010

Usage

```
data("dow.rate")
```

Format

The format is: num [1:20656] 240 238 238 240 240 ...

Source

Public access

References

"Applied Statistics and Data Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(dow.rate)
```

`dow1000` *Dow Jones daily rate of return data for 1000 days*

Description

Dow Jones daily rate of return for the 1000 trading days before December 31, 2010.

Usage

```
data("dow1000")
```

Format

The format is: num [1:1001] 240 238 238 240 240 ...

Source

Internet and shown in Figure 4.9, "Applied Time Series Analysis with R, 2nd edition", by Woodward, Gray and Elliott

Examples

```
data(dow1000)
```

`dow1985` *Daily DOW Closing Prices 1985 through 2020*

Description

Daily DOW Closing Prices 1985 through 2020

Usage

```
data("dow1985")
```

Format

ts object consisting of daily dow closing prices from 1985 through 2020

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(dow1985)
```

`dowjones2014` *Dow Jones daily averages for 2014*

Description

Daily Dow Jones averages for 2014

Usage

```
data("dowjones2014")
```

Format

The format is: num [1:252] 16441 16470 16425 16531 16463 ...

Source

Economic Data: Federal Reserve Bank of St. Louis. Website: https://research.stlouisfed.org/fred2/series/DJIA/downloaddata

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(dowjones2014)
```

eco.cd6 *6-month rates*

Description

6-month rates 1/1/1991 through 4/1/2010

Usage

```
data("eco.cd6")
```

Format

The format is: num [1:469] 7.25 7.53 7.64 7.64 7.59 7.44 7.39 7.26 7.25 7.19 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(eco.cd6)
```

eco.corp.bond *Corporate bond rates*

Description

Corporate bond rates 1/1/1991 through 4/1/2010

Usage

```
data("eco.corp.bond")
```

Format

The format is: num [1:469] 4.61 5.22 5.69 6.04 6.06 5.91 5.43 5.04 4.89 4.26 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(eco.corp.bond)
```

`eco.mort30` *30 year mortgage rates*

Description

30-year mortgage rates 1/1/1991 through 4/1/2010

Usage

```
data("eco.mort30")
```

Format

The format is: num [1:469] 7.31 7.43 7.53 7.6 7.7 7.69 7.63 7.55 7.48 7.44 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(eco.mort30)
```

`est.ar.wge` *Estimate parameters of an AR(p) model*

Description

Estimate parameters of an AR(p) with p assumed known. Outputs residuals (backcast0 and white noise variance estimate.)

Usage

```
est.ar.wge(x, p = 2, factor = TRUE, method = "mle")
```

Arguments

`x`	Realization
`p`	AR order
`factor`	If TRUE (default) a factor table is printed for the estimated model
`method`	Either "mle" (default), "burg", or "yw"

Details

The 'type' arument is added for backwards compatabililty and if specified will replace the value specified in the 'method' argument.

Value

`method`	Estimation method used: MLE, Burg, or YW
`phi.est`	Estimates of the AR parameters
`res`	Estimated residuals (using backcasting) based on estimated model
`avar`	Estimated white noise variance (based on backcast residuals)
`xbar`	Sample mean of data in x
`aic`	AIC for estimated model
`aicc`	AICC for estimated model
`bic`	BIC for estimated model

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.1nf)
         est.ar.wge(fig6.1nf,p=1)
```

`est.arma.wge` *Function to calculate ML estimates of parameters of stationary ARMA models*

Description

This function calculates ML estimates, computes residuals (using backcasting), estimates white noise variance for a stationary ARMA model

Usage

```
est.arma.wge(x, p = 0, q = 0, factor = TRUE)
```

Arguments

`x`	The realization.
`p`	The autoregressive order
`q`	the moving average order
`factor`	Logical variable. factor=TRUE (default) plots a factor table for estimated AR-part of model

Details

This function uses arima from base SAS and is written similarly to itsmr function arma

Value

`phi`	ML estimates of autoregressive parameters
`theta`	ML estimates of moving average parameters
`res`	Residuals (calculated using backcasting)
`avar`	Estimate of white noise variance based on backcast residuals
`se.phi`	Standard errors of the AR parameter estimates
`se.theta`	Standard errors of the MA parameter estimates
`aic`	AIC for estimated model
`aicc`	AICC for estimated model
`bic`	BIC for estimated model

Note

Requires CRAN package 'itsmr'. The program is based on arima from base R and arma from 'itsmr'

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.2nf)
         est.arma.wge(fig6.2nf,p=2,q=1)
```

`est.farma.wge` *Estimate the parameters of a FARMA model.*

Description

This function uses the grid search algorithm discussed in Section 11.5 of Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
est.farma.wge(x, low.d, high.d, inc.d, p.max, nback = 500)
```

Arguments

x	Realization to be analyzed
low.d	The lower limit for d in the grid search
high.d	The upper limit for d in the grid search
inc.d	The increment, e.g. .01, .001, etc. in the grid search
p.max	Maximum value of p allowed for the AR component of the model
nback	Number of backcasts to be used (see section 11.5 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Details

We assume q=0 and do not allow moving average terms in the model.

Value

d	Estimate of d
phi	Estimates of the pth order AR component of the model where p is some integer from 0 to p.max
vara	The estimnated white noise variance
aic	The aic value associated with the final model

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott. See also Hosking (1984)

Examples

```
est.farma.wge(Nile,low.d=.1,high.d=.5,inc.d=.01,p.max=3)
```

---

est.garma.wge *Estimate the parameters of a GARMA model.*

Description

This function uses the grid search algorithm discussed in Section 11.5 of Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
est.garma.wge(x,low.u,low.lambda,high.u,high.lambda,inc.u,inc.lambda,p.max,nback=500)
```

Arguments

`x`	Realization to be analyzed
`low.u`	The lower limit for u in the grid search
`low.lambda`	The lower limit for lambda in the grid search
`high.u`	The upper limit for u in the grid search
`high.lambda`	The upper limit for lambda in the grid search
`inc.u`	The increment, e.g. .01, .001, etc. in the grid search on possible u values
`inc.lambda`	The increment, e.g. .01, .001, etc. in the grid search on possible lambda values
`p.max`	Maximum value of p allowed for the AR component of the model
`nback`	Number of backcasts to be used (see section 11.5 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Details

We assume q=0 and do not allow moving average terms in the model.

Value

`u`	Estimate of u
`lambda`	Estimate of lambda
`phi`	Estimates of the pth order AR component of the model where p is some integer from 0 to p.max
`vara`	The estimated white noise variance
`aic`	The aic value associated with the final model

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott. See also Hosking (1984), Gray, Zhang, and Woodward(1989), and Woodward, Cheng, and Gray(1998)

Examples

```
data(llynx)
est.garma.wge(llynx,low.u=.4,high.u=.9,low.lambda=.2,high.lambda=.4,inc.u=.01,inc.lambda=.1,p.max=1)
```

---

est.glambda.wge *Estimate the value of lambda and offset to produce a stationary dual.*

Description

This function uses the technique discussed in Section 13.3.3 of Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott to find the g(lambda) time transformation that most nearly transforms the data to a stationary dual.

Usage

```
est.glambda.wge(data, lambda.range = c(0, 1), offset.range = c(0, 100))
```

Arguments

`data`	Vector containing the TVF realization to be analyzed
`lambda.range`	Range of lambda values considered in the search
`offset.range`	Range of offset values considered in the search

Value

`Q`	A listing of lambda values within the range and offsets for each lambda that provided the best dual. Also a listing of the test statistic, Q, to be minimized
`best.lambda`	See description of best.offset below
`best.offset`	best.lambda and best.offset are the lambda-offset pair that produced the most stationary dual according to the Q criterion

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott and Jiang, Gray, and Woodward(2006)

Examples

```
data(ss08)
                    est.glambda.wge(ss08,lambda.range=c(-1,1),offset.range=c(0,100))
```

`expsmooth.wge` *Exponential Smoothing*

Description

Performs exponential smoothing on the data in vector x

Usage

```
expsmooth.wge(x,alpha=NULL,n.ahead=0,plot=TRUE)
```

Arguments

`x`	Vector containing realization
`alpha`	Alpha value
`n.ahead`	Number of steps ahead to forecast
`plot`	If plot=TRUE then plots of the data along with forecasts

Value

`alpha`	alpha value used in the smoothing
`u`	forecasts

Author(s)

Wayne Woodward

References

"Time Series for Data Science" by Woodward, Sadler, and Robertson

Examples

```
data(wtcrude2020)
expsmooth.wge(wtcrude2020)
```

factor.comp.wge *Create a factor table and AR components for an AR realization*

Description

This program finds the ML estimates of a specified order, then prints a factor table for the estimated model and prints and plots the additive components

Usage

```
factor.comp.wge(x, aic = FALSE, p, ncomp)
```

Arguments

x	Realization
aic	The program calls basic R function phi.burg to calculate burg estimates of an AR fit to the data. Aic is turned off and the user specifies the order
p	Order of AR to fit to data
ncomp	Number of additive components to calculate and plot

Value

ncomp	The number of additive components
x.comp	Matrix (i,j) where i designates the component and j denotes time, i.e. (i,j) denotes the ith component at time j

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Elliott, and Gray

Examples

```
data(ss08)
    factor.comp.wge(ss08,p=9,ncomp=4)
```

factor.wge	*Produce factor table for a kth order AR or MA model*

Description

This program produces a factor table that reduces a kth order factor into its first and irreducible second order factors as described in Section 3.2.11 of "Applied Time Series Analysis" by Woodward, Gray, and Elliott

Usage

```
factor.wge(phi=0, theta=0)
```

Arguments

`phi`	Vector containing the coefficients of the kth order AR factor which is to be factored
`theta`	Vector containing the coefficients of the kth order MA factor which is to be factored

Value

The only output is the factor table, written by default to the console

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
factor.wge(phi=c(-.3,.44,.29,-.378,-.648))
```

`fig1.10a` *Simulated data shown in Figure 1.10a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

This is the sum of the three signals in fig1.10b, fig1.10c, and fig1.10d

Usage

```
data("fig1.10a")
```

Format

The format is: num [1:1000] 0.0217 -0.1528 -0.3141 -0.4613 -0.5934 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.10a)
```

`fig1.10b` *Simulated data shown in Figure 1.10b in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Low frequency component of Figure 1.10a

Usage

```
data("fig1.10b")
```

Format

The format is: num [1:1000] 1 1 0.999 0.998 0.997 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.10b)
```

`fig1.10c` *Simulated data in Figure 1.10c in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Middle frequencies component in Figure 1.10a

Usage

```
data("fig1.10c")
```

Format

The format is: num [1:1000] 0.73 0.646 0.56 0.471 0.381 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.10c)
```

`fig1.10d` *Simulated data in Figure 1.10d in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

High frequency component of Figure 1.10a

Usage

```
data("fig1.10d")
```

Format

The format is: num [1:1000] -1.71 -1.8 -1.87 -1.93 -1.97 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.10d)
```

`fig1.16a` *Simulated data for Figure 1.16a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Data containing two dominant frequencies

Usage

```
data("fig1.16a")
```

Format

The format is: num [1:250] -0.89 -3.209 0.929 -0.763 -1.972 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.16a)
```

---

fig1.21a *Simulated shown in Figure 1.21a of Woodward, Gray, and Elliott text*

Description

Simulated shown in Figure 1.21a of Woodward, Gray, and Elliott text. It illustrates the fact that frequency information is displayed better in the spectrum than the autocorrelations.

Usage

```
data("fig1.21a")
```

Format

The format is: num [1:250] -0.89 -3.209 0.929 -0.763 -1.972 ...

Source

Simulated by the authors of the Woodward, Gray, and Elliott text

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig1.21a)
```

`fig1.22a` *White noise data*

Description

Realization of length n=250 of white noise data, Figure 1.22a in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig1.22a")
```

Format

The format is: num [1:250] 0.302 -0.691 -0.477 0.814 -0.267 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig1.22a)
```

`fig1.5` *Simulated data shown in Figure 1.5 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated data from an ergodic AR(1) process

Usage

```
data("fig1.5")
```

Format

The format is: num [1:100] 0.739 -0.39 0.15 -0.627 0.262 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig1.5)
```

`fig10.11x` *Simulated data shown in Figure 10.11 (solid line) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated unobservable AR(1) data in Example 10.11

Usage

```
data("fig10.11x")
```

Format

The format is: num [1:75] -0.2497 -0.0812 -0.6463 -1.7653 -2.719 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig10.11x)
```

`fig10.11y` *Simulated data shown in Figure 10.11 (dashed line) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated observed AR(1) plus noise data in Example 10.11

Usage

```
data("fig10.11y")
```

Format

The format is: num [1:75] -0.74 0.045 -0.775 -2.944 -2.278 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig10.11y)
```

`fig10.1bond` *Data for Figure 10.1b in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Moody's seasoned Aaa corporate bond rate, January 1, 1991-April1, 2010

Usage

```
data("fig10.1bond")
```

Format

The format is: num [1:232] 7.17 6.51 6.5 6.16 6.03 6.26 6.25 5.79 5.6 5.32 ...

Source

Internet

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig10.1bond)
```

`fig10.1cd` *Data shown in Figure 10.1a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

6 month CD rate for January 1, 1991 - April 1, 2010

Usage

```
data("fig10.1cd")
```

Format

The format is: num [1:232] 9.04 8.83 8.93 8.86 8.86 9.01 9 8.75 8.61 8.55 ...

Source

Internet

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig10.1cd)
```

`fig10.1mort` *Data shown in Figure 10.1c in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

30 year conventional mortgage rates: January 1, 1991-April1, 2010

Usage

```
data("fig10.1mort")
```

Format

The format is: num [1:232] 9.64 9.37 9.5 9.49 9.47 9.62 9.58 9.24 9.01 8.86 ...

Source

Internet

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig10.1mort)
```

`fig10.3x1` *Variable X1 for the bivariate realization shown in Figure 10.3"*

Description

Variable X1 for the bivariate Var1) realization in Figure 10.3 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig10.3x1")
```

Format

The format is: num [1:75] -0.0757 -0.2728 -0.8089 -2.4747 -5.9256 ...

Source

Simulated Var(1) data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig10.3x1)
```

`fig10.3x2` *Variable X2 for the bivariate realization shown in Figure 10.3"*

Description

Variable X2 for the bivariate Var1) realization in Figure 10.3 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig10.3x2")
```

Format

The format is: num [1:75] 0.646 -1.313 -0.191 -2.61 -4.925 ...

Source

Simulated Var(1) data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig10.3x2)
```

`fig11.12` *Data shown in Figure 11.12a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated GATMA(1,0) data

Usage

```
data("fig11.12")
```

Format

The format is: num [1:500] 2.18 -1.17 -3.13 -1.32 1.69 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig11.12)
```

`fig11.4a` *Data shown in Figure 11.4a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated FARMA(2,0) data

Usage

```
data("fig11.4a")
```

Format

The format is: num [1:100] 1.361 -0.369 0.881 2.362 0.236 ...

Source

simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig11.4a)
```

---

fig12.1a *Simulated data with two frequencies shown in Figure 12.1a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated two-frequency data in which the two frequencies are separated in time

Usage

```
data("fig12.1a")
```

Format

The format is: num [1:200] -1.22 -6.06 -9.66 -10.14 -8.58 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig12.1a)
```

`fig12.1b` *Simulated data with two frequencies shown in Figure 12.1b in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated two-frequency AR(4) data

Usage

```
data("fig12.1b")
```

Format

The format is: num [1:256] 10.081 10.835 0.532 -5.495 1.294 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig12.1b)
```

`fig13.18a` *Simulated data shown in Figure 3.18a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated AR(4) data

Usage

```
data("fig13.18a")
```

Format

The format is: num [1:400] 1.251 1.0019 -0.0317 -1.0167 -1.4222 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig13.18a)
```

`fig13.2c` *TVF data shown in Figure 13.2c in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Realization from an Euler(2) model

Usage

```
data("fig13.2c")
```

Format

The format is: num [1:200] -13.14 -11.03 22.06 -8.92 -16.67 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig13.2c)
```

fig3.10d *AR(2) Realization (1-.95)^2X(t)=a(t)*

Description

AR(2) Realization (1-.95)^2X(t)=a(t) plotted in Figure 3.10d in "Applied Time series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig3.10d")
```

Format

The format is: num [1:100] 15.3 16.3 18.6 21.2 22.8 ...

Details

This realization is also used in Chapter 7 of text above for testing estimation techniques

Source

Simulated realization

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.10d)
```

fig3.16a *Figure 3.16a in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

Realization from the AR(3) model in Figure 3.16a

Usage

```
data("fig3.16a")
```

Format

The format is: num [1:200] -0.0686 0.4304 0.4786 0.9899 3.4047 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.16a)
```

`fig3.18a` *Figure 3.18a in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

Realization from the AR(3) model in Figure 3.18a

Usage

```
data("fig3.18a")
```

Format

The format is: num [1:200] -0.573 -0.837 -1.16 1.078 -0.561 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.18a)
```

`fig3.24a` *ARMA(2,1) realization*

Description

ARMA(2,1) realization of length n=200 phi(1)=1.6,phi(2)=-.9,theta(1)=.8 (using Box-Jenkins-Reinsel notation)

Usage

```
data("fig3.24a")
```

Format

The format is: num [1:200] 0.685 -1.234 -0.714 0.796 -0.96 ...

Source

Simulated data

References

Fig3.24a in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig3.24a)
```

`fig3.29a` *Simulated data shown in Figure 3.29a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated data from stationary seasonal model

Usage

```
data("fig3.29a")
```

Format

The format is: num [1:20] -7.23 -6.99 -6.9 -6.26 -3.79 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig3.29a)
```

`fig4.8a` *Gaussian White Noise*

Description

Gaussian White Noise, n=1000 shown in Figure 4.8a in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig4.8a")
```

Format

The format is: num [1:1000] -0.585 0.177 0.284 -0.271 0.126 ...

Source

Simulated data

References

Plotted in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig4.8a)
```

`fig5.3c` *Data from Figure 5.3c in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

Realization of length 200 from the AR(3) model (1-.995B)(1-1.2B+.8B^2)X(t)=a(t)

Usage

```
data("fig5.3c")
```

Format

The format is: num [1:200] -0.503 -0.811 -0.188 1.34 2.982 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig5.3c)
```

`fig6.11a` *Cyclical Data*

Description

First 50 points of data in Figure 6.11a, Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
data("fig6.11a")
```

Format

The format is: num [1:50] -0.682 0.15 2.262 3.079 4.122 ...

Source

Simulated

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig6.11a)
```

---

fig6.1nf *Data in Figure 6.1 without the forecasts*

Description

Realization from the AR(1) model (1-.8B)(X(t)-25)=a(t) in Figure 6.2 and also shown in Table 6.1 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig6.1nf")
```

Format

The format is: num [1:80] 25.1 27.1 27.3 25.7 23.9 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.1nf)
```

`fig6.2nf` *Data in Figure 6.2 without the forecasts*

Description

Realization from the ARMA(2,1) model (1-1.2B+.6B^2)(X(t)-50)=(1-.5B)a(t) in Figure 6.2 and also shown in Table 6.1 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig6.2nf")
```

Format

The format is: num [1:25] 49.5 51.1 50 49.7 50.4 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.2nf)
```

`fig6.5nf` *Data in Figure 6.5 without the forecasts*

Description

Realization from the ARIMA(0,1,0) model for realization in Figure 6.5 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig6.5nf")
```

Format

The format is: num [1:50] 105 104 103 102 102 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.5nf)
```

---

fig6.6nf *Data in Figure 6.6 without the forecasts*

Description

Realization from the ARIMA(1,1,0) model (1-.8B)(1-B)X(t)=a(t) for realization in Figure 6.6 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig6.6nf")
```

Format

The format is: num [1:50] 139 138 138 140 141 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.6nf)
```

fig6.7nf *Data in Figure 6.2 without the forecasts*

Description

Realization from the ARIMA(0,2,0) model for realization in Figure 6.7 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("fig6.7nf")
```

Format

The format is: num [1:50] -582 -579 -578 -578 -579 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.7nf)
```

fig6.8nf *Simulated seasonal data with s=12*

Description

Simulated seasonal data designed for showing seasonal forecasts

Usage

```
data("fig6.8nf")
```

Format

The format is: num [1:48] 5.8 13.66 9.83 7.33 6.96 ...

Source

Simulated Data

References

"Applied Time series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.8nf)
```

`fig8.11a` *Data for Figure 8.11a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Realization of length n=200 from the model (1-B)(1-1.79B+1.75B^2-1.61B^3+.765B^4)X(t)=a(t)

Usage

```
data("fig8.11a")
```

Format

The format is: num [1:200] 83.2 80.9 78.9 80.4 85.4 ...

Source

Simulated data

References

Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig8.11a)
```

fig8.4a *Data for Figure 8.4a in Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Realization of length n=200 from the model (1-.8B)(1-1.6B+.995B^2)X(t)=a(t)

Usage

```
data("fig8.4a")
```

Format

The format is: num [1:200] 13.45 -5.52 -19 -21.26 -13.63 ...

Source

simulated data

References

Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig8.4a)
```

fig8.6a *Data for Figure 8.6a in Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

The realization of length n=200 is from the model (1-B)^2(1-1.2B+.6B^2)X(t)=a(t)

Usage

```
data("fig8.6a")
```

Format

The format is: num [1:200] 354 368 383 399 417 ...

Source

Simulated data

References

Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig8.6a)
```

`fig8.8a` *Data for Figure 8.8a in Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Realization of length n=200 from the model (1-B^12)(1-1.25B+.9B^2)(X(t)-50)=a(t)

Usage

```
data("fig8.8a")
```

Format

The format is: num [1:200] 48.9 42.9 49.3 57.3 55.5 ...

Source

Simulated data

References

Applied time series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig8.8a)
```

flu — *Influenza data shown in Figure 10.8 (dotted line)*

Description

Annual influenza rate for years 1970-2005

Usage

```
data("flu")
```

Format

The format is: num [1:36] 9.75 5.82 10.99 10.41 8.42 ...

Source

Alder, et al. (2010)Archives of Surgery 145, 63-71

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(flu)
```

fore.arima.wge — *Function for forecasting from known model which may have (1-B)^d and/or seasonal factors*

Description

This function calculates forecasts from a known model that may have stationary ARMA components as well as (1-B)^dand/or seasonal factors

Usage

```
fore.arima.wge(x,phi=0,theta=0,d=0,s=0,n.ahead=5,lastn=FALSE,plot=TRUE,alpha=.05,limits)
```

Arguments

`x`	Realization to be forecast from
`phi`	Vector containing stationary AR parameters
`theta`	Vector containing MA parameters
`d`	Order of difference
`s`	Seasonal order
`n.ahead`	Number of steps ahead to forecast
`lastn`	Logical, lastn=TRUE plots forecasts for the last n.ahead values in the realization
`plot`	Logical, plot=TRUE plots forecasts
`alpha`	Significance level for prediction limits
`limits`	Logical, limits=TRUE plots prediction limits

Value

`f`	Vector of forecasts
`ll`	Lower limits
`ul`	Upper limits
`resid`	Residuals
`wnv`	White noise variance estimate
`xbar`	Sample mean of data in x
`se`	Se for each forecast
`psi`	Psi weights
`ptot`	Total order of all AR components, phi, d, and s
`phtot`	Coefficients after multiplying all stationary and nonstationary coponents on the AR side of the equation

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(airline)
         x=log(airline)
         phi12=c(-.36,-.05,-.14,-.11,.04,.09,-.02,.02,.17,.03,-.1,-.38)
         s=12
         d=1
         fore.arima.wge(x,phi=phi12,d=1,s=12,n.ahead=12,limits=FALSE)
```

`fore.arma.wge` *Forecast from known model*

Description

Forecasts and associated plots for an ARMA model

Usage

```
fore.arma.wge(x,phi=0,theta=0,n.ahead=5,lastn=FALSE,plot=TRUE,alpha=.05,limits=TRUE)
```

Arguments

`x`	Realization
`phi`	AR vector
`theta`	MA vector
`n.ahead`	Number of steps ahead
`lastn`	Logical variable, TRUE means plot forecast for last n.ahead values of realization
`plot`	Logical variable , TRUE means plot forecasts
`alpha`	Significance level for prediction limits
`limits`	Logical variable, TRUE means plot limits

Value

`f`	Vector of forecasts
`ll`	Lower limits
`ul`	Upper limits
`resid`	Residuals
`wnv`	White noise variance estimate
`xbar`	Sample mean of data in x
`se`	Se for each forecast
`psi`	psi weights
`rmse`	RMSE is output if lastn=TRUE
`mad`	MAD is output if lastn=TRUE

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig6.1nf)
fore.arma.wge(fig6.1nf,phi=.8,n.ahead=20)
```

`fore.aruma.wge` *Function for forecasting from known model which may have (1-B)^d, seasonal, and/or other nonstationary factors*

Description

This function calculates forecasts from a known model that may have stationary ARMA components as well as (1-B)^d, seasonal, and/or other nonstationary factors

Usage

```
fore.aruma.wge(x,phi=0,theta=0,d=0,s=0,lambda=0,n.ahead=5,
lastn=FALSE,plot=TRUE,alpha=.05,limits=TRUE)
```

Arguments

`x`	Realization to be forecast from
`phi`	Vector containing stationary AR parameters
`theta`	Vector containing MA parameters
`d`	Order of difference
`s`	Seasonal order
`lambda`	Vector containing coefficients of nonstationary factors not covered by the difference or the seasonal factors
`n.ahead`	Number of steps ahead to forecast
`lastn`	Logical, lastn=TRUE plots forecasts for the last n.ahead values in the realization
`plot`	Logical, plot=TRUE plots forecasts
`alpha`	Alpha for prediction limits
`limits`	Logical, limits=TRUE plots prediction limits

Value

`f`	Vector of forecasts
`ll`	Lower limits
`ul`	Upper limits
`resid`	Residuals
`wnv`	White noise variance estimate
`xbar`	Sample mean of data in x
`se`	Se for each forecast

psi	Psi weights
ptot.fore	Total order of all AR components, phi, d, s, and lambda
phtot.fore	Coefficients after multiplying all stationary and nonstationary coponents on the AR side of the equation

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(airline)
         x=log(airline)
         phi12=c(-.36,-.05,-.14,-.11,.04,.09,-.02,.02,.17,.03,-.1,-.38)
         s=12
         d=1
         fore.aruma.wge(x,phi=phi12,d=1,s=12,n.ahead=12,limits=FALSE)
```

---

fore.farma.wge *Forecast using a FARMA model*

Description

Find forecasts using a specified FARMA model

Usage

```
fore.farma.wge(x, d,  phi, theta = 0, n.ahead = 10, lastn = TRUE, plot = TRUE)
```

Arguments

x	Realization to be analyzed
d	Parameter d in FARMA model
phi	Coefficients of the AR component of the FARMA model
theta	Coefficients of the MA component of the FARMA model
n.ahead	Number of values to forecast
lastn	If lastn=TRUE then the last n.ahead values are forecast. Otherwise, if lastn=FALSE the next n.ahead values are forecast
plot	If plot=TRUE then plots of the data and forecasts are plotted

Details

Forecasts for an AR model fit to the data are also calculated and optionally plotted

Value

ar.fit.order	Order of the AR model fit to the data
ar.fore	Forecasts based on the AR model
farma.fore	Forecasts based on the FARMA model

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
fore.farma.wge(Nile, d=.37, phi=0, theta = 0, n.ahead = 30, lastn = TRUE, plot = TRUE)
```

---

fore.garma.wge   *Forecast using a GARMA model*

Description

Find forecasts using a specified GARMA model

Usage

```
fore.garma.wge(x,u,lambda,phi,theta=0,n.ahead=10,lastn=TRUE,plot=TRUE)
```

Arguments

x	Realization to be analyzed
u	Parameter u in GARMA model
lambda	Parameter lambda in GARMA model
phi	Coefficients of the AR component of the GARMA model
theta	Coefficients of the MA component of the GARMA model
n.ahead	Number of values to forecast
lastn	If lastn=TRUE then the last n.ahead values are forecast. Otherwise, if lastn=FALSE the next n.ahead values are forecast
plot	If plot=TRUE then plots of the data and forecasts are plotted

Details

Forecasts for an AR model fit to the data are also calculated and optionally plotted

Value

ar.fit.order	Order of the AR model fit to the data
ar.fore	Forecasts based on the AR model
garma.fore	Forecasts based on the GARMA model

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(llynx)
fore.garma.wge(llynx,u=.796,lambda=.4,phi=.51,theta=0,n.ahead=30,lastn=TRUE,plot=TRUE)
```

---

fore.glambda.wge — *Forecast using a G(lambda) model*

Description

Find forecasts using a specified G(lambda) model

Usage

```
fore.glambda.wge(data.orig,lambda=0,offset=60,phi=0,h=0,n.ahead=10,lastn=TRUE,plot=TRUE)
```

Arguments

data.orig	Time series data in the original time scale
lambda	The value of lambda under the Box-Cox time transformation with parameter lambda.
offset	Offset (or shift) value in the G(lambda) model.
phi	Coefficients of the AR component of the AR model fit to the dual data
h	Value of h which will be calculated to produce the desired number of forecasts in the original time scale
n.ahead	Number of values to forecast
lastn	If lastn=TRUE then the last n.ahead values are forecast. Otherwise, if lastn=FALSE the next n.ahead values are forecast
plot	If plot=TRUE then plots of the data and forecasts are plotted

Details

Forecasts for an AR model fit to the data in the original time scale are also calculated and optionally plotted

Value

`f.ar`	Forecasts using AR model fit to data in original time
`f.glam`	Forecasts using AR model fit to the dual and then reinterpolated

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig13.2c)
fore.glambda.wge(fig13.2c,lambda=-.4,offset=63,phi=c(0.93,-0.32,-0.15,-0.15,-0.17),n.ahead=30)
```

`fore.sigplusnoise.wge` *Forecasting signal plus noise models*

Description

Forecast models of the form line plus AR noise or cosine plus AR noise with known frequency

Usage

```
fore.sigplusnoise.wge(x,linear=TRUE,method="mle",freq=0,max.p=5,
n.ahead=10,lastn=FALSE,plot=TRUE,alpha=.05,limits=TRUE)
```

Arguments

`x`	The variable containing the realization to be analyzed
`linear`	If TRUE then the program forecasts a line plus noise model. If FALSE the model is cosine plus noise
`method`	Estimation method
`freq`	Frequency of the cosine term. freq is ignored when using line plus noise
`max.p`	Max value of p for the ARp model fit to the noise
`n.ahead`	The number of steps ahead to forecast
`lastn`	If TRUE then the function forecasts the last n.ahead values of the realization. If FALSE the the forecasts are for n.ahead steps beyond the end of the realization
`plot`	If TRUE then the forecasts and realization are plotted
`alpha`	Significance level
`limits`	If TRUE the forecast limits calculated and plotted

Value

`f`	The n.ahead forecasts
`ll`	The lower limits for the forecasts. zeros are returned if limits were not requested
`ul`	The upper limits for the forecasts. zeros are returned if limits were not requested
`res`	Residuals
`wnv`	The estimated white noise variance based on the residuals
`se`	se is the estimated standard error of the k step ahead forecast. zeros are returned if limits were not requested
`xi`	xi is the kth psi weight associated with the fitted AR model and used to calculate the se above. Note that psi0 is1. zeros are returned if limits were not requested

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(llynx)
llynx.for=fore.sigplusnoise.wge(llynx,linear=FALSE,freq=.1,max.p=5,n.ahead=20)
```

`freeze` *Minimum temperature data*

Description

Each data value represents the minimum temperature over 10-day period at a location in South America

Usage

```
data("freeze")
```

Format

The format is: num [1:500] 8.2 12.3 9.2 8.4 10 8.8 6.8 4.8 5.2 1.7 ...

Source

Unknown

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(freeze)
```

`freight` *Freight data*

Description

9 years of monthly freight shipment data

Usage

```
data("freight")
```

Format

The format is: num [1:120] 1299 1148 1345 1363 1374 ...

Source

Unknown

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(freight)
```

`gegenb.wge` *Calculates Gegenbauer polynomials*

Description

Calculates Gegenbauer polynomials of order n with parameters u and lambda - see (11.9) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
gegenb.wge(u, d, n)
```

Arguments

`u`	Parameter u in (11.9) Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott
`d`	Parameter lambda in (11.9) Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott
`n`	Order of Gegenbauer polynomial in (11.9)

Details

This function is called by gen.garma.wge

Value

The coefficients of the nth order Gegenbauer polynomial

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
gegenb.wge(u=.8,d=.3,n=6)
```

---

gen.arch.wge *Generate a realization from an ARCH(q0) model*

Description

Generates a realization of length n from the GARCH(q0) model (4.23) in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
gen.arch.wge(n, alpha0, alpha, plot = TRUE,sn=0)
```

Arguments

`n`	Length of realization to be generated
`alpha0`	The constant alpha0 in model (4.23)
`alpha`	A vector of length q0 containing alpha1 through alphaq0
`plot`	If plot=TRUE (default) the generated realization is plotted
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

returns the generated realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.arch.wge(n=200,alpha0=.1,alpha=c(.36,.27,.18,.09))
```

`gen.arima.wge` *Function to generate an ARIMA (or ARMA) realization*

Description

This function calls arima.sim but with more simple parameter structure for stationary ARIMA (or ARMA) models

Usage

```
gen.arima.wge(n, phi=0, theta=0, d=0,s=0,mu=0,vara=1,plot=TRUE,sn=0)
```

Arguments

`n`	Length of realization to be generated
`phi`	Vector of AR coefficients
`theta`	Vector of MA coefficients
`d`	Order of the difference
`s`	Seasonal order
`vara`	White noise variance, default=1
`mu`	Theoretical mean of data in x, default=0
`plot`	Logical: TRUE=plot, FALSE=no plot
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

This function simply generates and (optionally plots) an ARIMA (or ARMA) realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.arima.wge(n=100, phi=c(1.6,-.9), theta=.8, d=1, vara=1, plot=TRUE)
```

`gen.arma.wge` *Function to generate an ARMA realization*

Description

This function calls arima.sim but with more simple parameter structure for stationary ARMA models

Usage

```
gen.arma.wge(n, phi=0, theta=0, mu=0,vara = 1,plot = TRUE,sn=0)
```

Arguments

`n`	Length of realization to be generated
`phi`	Vector of AR coefficients
`theta`	Vector of MA coefficients
`vara`	White noise variance, default=1
`mu`	Theoretical mean, default=0
`plot`	Logical: TRUE=plot, FALSE=no plot
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

This function simply generates and (optionally plots) an ARMA realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.arma.wge(n=100, phi=c(1.6,-.9), theta=.8, mu=50,vara=1, plot=TRUE)
```

`gen.aruma.wge` *Function to generate an ARUMA (or ARMA or ARIMA) realization*

Description

This function calls arima.sim but an a similar manner to gen.ns.arma.wge and gen.ns.arima.wge but allows for generation of realizations from ARUMA models (see Chapter 5 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
gen.aruma.wge(n,phi=0,theta=0,d=0,s=0,lambda=0,vara=1,plot=TRUE,sn=0)
```

Arguments

`n`	Length of realization to be generated
`phi`	Vector of AR coefficients
`theta`	Vector of MA coefficients
`d`	Order of the difference
`s`	Order of seasonal operator
`lambda`	Vector of nonstaionary coefficients not associated with d or s (see Def. 5.1(b) in Woodward, Gray, and Elliott text)
`vara`	White noise variance, default=1
`plot`	Logical: TRUE=plot, FALSE=no plot
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

This function generates and (optionally plots) an ARMA or ARIMA or ARUMA realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.aruma.wge(n=100,phi=.7,theta=0, d=1, s=4,lambda=c(1.8,-1),vara=1, plot=TRUE)
```

gen.garch.wge   *Generate a realization from a GARCH(p0,q0) model*

Description

Generates a realization of length n from the GARCH(p0,q0) model (4.26) in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
gen.garch.wge(n,alpha0,alpha,beta,plot=TRUE,sn=0)
```

Arguments

`n`	Length of realization to be generated
`alpha0`	The constant alpha0 in model (4.23)
`alpha`	A vector of length q0 containing alpha1 through alphaq0
`beta`	A vector of length p0 containing beta1 through betap0
`plot`	If plot=TRUE (default) the generated realization is plotted
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

returns the generated realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.garch.wge(n=200,alpha0=.1,alpha=.45,beta=.45)
```

`gen.garma.wge` *Function to generate a GARMA realization*

Description

This function calls gen.geg.wge and arima.sim

Usage

```
gen.garma.wge(n,u,lambda,phi = 0,theta=0,trun=300000,burn_in=600,vara=1,plot=TRUE,sn=0)
```

Arguments

`n`	the realization length to be generated
`u`	Parameter u in the GARMA model given in (11.16) of Woodward, Gray, and Elliott text
`lambda`	Parameter lambda in the GARMA model given in (11.16) of Woodward, Gray, and Elliott text
`phi`	vector of AR parameters of ARMA part of GARMA model
`theta`	vector of MA parameters of ARMA part of GARMA model using signs as given ijn the Woodward, Grayu, and Elliott text
`trun`	the truncation point of the infinite GLP form
`burn_in`	is the burning-in period for the simulation
`vara`	White noise variance, default=1
`plot`	Logical: TRUE=plot, FALSE=no plot
`sn`	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

This function generates and (optionally plots) an GARMA realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.garma.wge(n=100, u=.8,lambda=.4,phi=.9)
```

gen.geg.wge *Function to generate a Gegenbauer realization*

Description

This function calls macoef.wge

Usage

```
gen.geg.wge(n, u, lambda, trun = 300000,  vara=1 ,sn = 0)
```

Arguments

n	the realization length to be generated
u	Parameter u in the Gegenbauer model given in (11.12) of Woodward, Gray, and Elliott text
lambda	Parameter lambda in the Gegenbauer model given in (11.12) of Woodward, Gray, and Elliott text
trun	the truncation point of the infinite GLP form
vara	White noise variance, default=1
sn	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Details

This function is called by gen.garma.wge and does not have a burn-in time. Thus, we recommend using est.garma.wge for generating realizations from a Gegenbauer model.

Value

This function generates a Gegenbauer realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.geg.wge(n=100, u=.8,lambda=.4)
```

gen.glambda.wge *Function to generate a g(lambda) realization*

Description

This function generates a g(lambda) TVF realization as discussed in Chapter 13 of Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
gen.glambda.wge(n, lambda, phi =0, offset = 20, vara = 1, plot = TRUE, sn = 0)
```

Arguments

n	Length of realization to be generated
lambda	The lambda involved in the g(lambda) time transformation - see Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott
phi	Vector of AR coefficients
vara	White noise variance, default=1
offset	The offset parameter in a g(lambda) process. See section 13.2 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott
plot	Logical: TRUE=plot, FALSE=no plot
sn	determines the seed used in the simulation. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time

Value

This function simply generates and (optionally plots) an ARMA realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
gen.glambda.wge(n=500, lambda=0.5,phi=c(1.9,-.99), vara=1, plot=TRUE,sn=0)
```

`gen.sigplusnoise.wge` *Generate data from a signal-plus-noise model*

Description

Generate a realization from the model x(t)=coef[1]*cos(2*pi*freq[1]*t+psi[1])+coef[2]*cos(2*pi*freq[2]*t+psi[2])+a(t)

Usage

```
gen.sigplusnoise.wge(n,b0,b1=0,coef,freq,psi,phi=0,vara=1,plot=TRUE,sn=0)
```

Arguments

`n`	length of realization to be generated
`b0`	y intercept of the linear component
`b1`	slope of the linear component
`coef`	a 2-component vector specifying the coefficients (if only one cosine term is desired define coef[2]=0)
`freq`	a 2-component vector specifying the frequency components (0 to .5)
`psi`	a 2-component vector specifying the phase shift (0 to 2pi)
`phi`	a vector of coefficients of the coefficients of the AR noise
`vara`	vara is the variance of the noise. NOTE: a(t) is a vector of N(0,WNV) noise generated within the function (default=1)
`plot`	if TRUE then plot the data generated (default=TRUE)
`sn`	determines the seed used in the simulation (default=0 indicating new realization each time). sn=positve integer, then the same realization is generated each time

Value

`x`	realization generated

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
x=gen.sigplusnoise.wge(n=100,coef=c(3,1),freq=c(.1,.4),psi=c(0,0),vara=2)
```

`global.temp` *Global Temperature Data: 1850-2009*

Description

Annual temperature anomalies from the average for the years 1850-2009

Usage

```
data("global.temp")
```

Format

The format is: List of 2 $ year : num [1:160] 1850 1851 1852 1853 1854 ... $ annual: num [1:160] -0.447 -0.292 -0.294 -0.337 -0.307 -0.321 -0.406 -0.503 -0.513 -0.349 ...

Source

Climatic Research Unit at East Anglia, England, in conjunction with the Met Office Hadley Centre

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(global.temp)
```

`global2020` *Global Temperature Data: 1880-2009*

Description

Annual temperature anomalies from the average for the years 1850-2009

Usage

```
data("global.temp")
```

Format

The format is: ts file containing annual temperatures from 1880 through 2020

Source

ncdc.noaa.gov

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(global2020)
```

`hadley` *Global temperature data*

Description

Global temperature data for 1850-2009. The data are temperature anomalies, i.e. departures from the average for 1850-2009

Usage

```
data("hadley")
```

Format

The format is: num [1:160] -0.447 -0.292 -0.294 -0.337 -0.307 -0.321 -0.406 -0.503 -0.513 -0.349 ...

Source

Met Office Hadley Centre

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(hadley)
```

`hilbert.wge` *Function to calculate the Hilbert transformation of a given real valued signal(even length)*

Description

Function is used with the tswge function wv.wge

Usage

```
hilbert.wge(input)
```

Arguments

`input`	realization to be analyzed

Value

`ans`	Hilbert transformation of the input

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(airline)
hilbert.wge(airline)
```

`is.glambda.wge` *Instantaneous spectrum*

Description

Calculates instantaneous spectrum (in dB) based on a G(lambda) time transformation

Usage

```
is.glambda.wge(n, phi = 0, sigma2 = 1, lambda, offset)
```

Arguments

n	Length of realization.
phi	Coefficients of AR model fit to dual data.
sigma2	White noise variance
lambda	Lambda in the G(lambda) time transformnation used
offset	Offset in the G(lambda) time transformnation used

Value

Simply a plot of the realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
is.glambda.wge(n=200,phi=c(.93,-.32,-.15,-.15,-.17),lambda=-.4,offset=63)
```

---

is.sample.wge *Sample instantaneous spectrum based on periodogram*

Description

Calculates sample instantaneous spectrum (in dB) based on a G(lambda) time transformation

Usage

```
is.sample.wge(data,  lambda, offset)
```

Arguments

data	Realization to be analyzed.
lambda	Lambda in the G(lambda) time transformation used
offset	Offset in the G(lambda) time transformation used

Value

Simply a plot of the realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(ss08)
is.sample.wge(data=ss08,lambda=-.4,offset=63)
```

---

kalman.miss.wge *Kalman filter for simple signal plus noise model with missing data*

Description

Kalman function to predict, filter, and smooth in the presence of missing data; see Section 10.6 4 in Applied Time Series Analysis with R

Usage

```
kalman.miss.wge(y,start, gam0, F, gamV, Gtmiss, gamW)
```

Arguments

`y`	the univariate data set to be analyzed
`start`	the scalar version of X(0) in item (c) following the state equation (10.47) of the text
`gam0`	the scalar version of Gamma(0) discussed in item (c) following the state equation
`F`	scalar version of the matrix F in the state equation
`gamV`	the value Gamma(v) specified in item (b) following the state equation
`Gtmiss`	specifies which items that are missing
`gamW`	the variance of the (univariate) white noise denoted by Gamma(w) in item (c) following (10.48)

Value

`pfs`	a table giving results such as those in Table 10.1 in Woodward, Gray, and Elliott book

Note

Calls Ksmooth1 in CRAN package 'astsa'

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(table10.1.signal)
data(table10.1.noise)
spn=table10.1.signal+table10.1.noise
n=75
Gtmiss=array(1,dim=c(1,1,n))
Gtmiss[1,1,2]=0
Gtmiss[1,1,5]=0
kalman.miss.wge(y=spn,start=0,gam0=1,F=.9,gamV=1,Gtmiss,gamW=.75)
```

---

kalman.wge *Kalman filter for simple signal plus noise model*

Description

Kalman filter program to predict, filter, and smooth related to the material in Section 10.6 4 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
kalman.wge(y, start, gam0, F, gamV, G, gamW)
```

Arguments

y	the univariate data set to be analyzed
start	the scalar version of Xo in item (c) following the state equation (10.47) of the text
gam0	the scalar version of Gamma(0) discussed in item (c) following the state equation
F	scalar version of the matrix F in the state equation
gamV	the value Gamma(v) specified in item (b) following the state equation
G	the scalar observation matrix specified in the observation equation as G(t)
gamW	the variance of the (univariate) white noise denoted by Gamma(w) in item (c) following (10.48)

Value

pfs	a table giving results such as those in Table 10.1 in Woodward, Gray, and Elliott book

Note

Requires CRAN package 'astsa'

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(table10.1.signal)
data(table10.1.noise)
spn=table10.1.signal+table10.1.noise
kalman.wge(y=spn,start=0,gam0=1,F=.9,gamV=1,G=1,gamW=.75)
```

`kingkong` *King Kong Eats Grass*

Description

Digitized record taken at 8,000 Hz of voltage readings obtained from the acoustical energy generated by Wayne Woodward speaking the words "King Kong eats grass" while a fan was blowing in the background

Usage

```
data("kingkong")
```

Format

The format is: num [1:15418] -0.001831 -0.000916 -0.003357 -0.002716 -0.000977 ...

Source

See description above

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(kingkong)
```

lavon — *Lavon lake water levels*

Description

Data given in feet above sea level. Quarterly data, 1982-2009

Usage

```
data("lavon")
```

Format

The format is: num [1:112] 495 492 500 491 492 ...

Source

http://lavon.uslakes.info/levelcal.asp

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(lavon)
```

lavon15 — *Lavon Lake Levels to September 30, 2015*

Description

Feet above sea level for Lavon Lake, quarterly data through September 2015. An extension of data lavon

Usage

```
data("lavon15")
```

Format

The format is: num [1:135] 495 492 500 491 492 ...

Source

Lake Data internet

Examples

```
data(lavon15)
```

`linearchirp` *Linear chirp data.*

Description

256 point linear chirp data, the first 150 points of which are shown in Figure 3.16(a) Time Series Analysis for Data Science: Analysis and Forecasting by Woodward, Sadler, and Robertson

Usage

```
data("linearchirp")
```

Format

The format is: List of 2 $ x : num [1:256] 1 1 0.98 0.95 0.91 0.86 0.8 0.72 0.63 0.53 ... $ spec: num [1:256] 0.511 0.568 0.733 0.991 1.32 ...

Source

Simulated data

References

Time Series Analysis for Data Science: Analysis and Forecasting by Woodward, Sadler, and Robertson

Examples

```
data(linearchirp)
```

`ljung.wge` *Ljung-Box Test*

Description

Performs Ljung-Box Test for white noise

Usage

```
ljung.wge(x, K = 24, p = 0, q = 0)
```

Arguments

x	Realization to assess for white noise
K	Maximum lag for sample autocorrelations to be used in test
p	If x is a realization of residuals from an ARMA(p,q) fit then p=AR order. Otherwise, p=0
q	If x is a realization of residuals from an ARMA(p,q) fit then q=MA order. Otherwise, q=0

Value

test	Name of test for output: Ljung-Box Test
K	Maximum lag : same as input value
chi.square	Value of chi-square statistic
df	Degrees of freedom = K-p-q
pvalue	pvalue for testing null hypothesis of white noise

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(fig1.22a)
ljung.wge(fig1.22a, K=24,p=0,q=0)
```

---

llynx *Log (base 10) of lynx data*

Description

The log (base 10) of the annual number of lynx trapped in the Mackenzie River district of the North-West Canada (dataset lynx in this package)

Usage

```
data("llynx")
```

Format

The format is: Time-Series [1:114] from 1821 to 1934: 2.43 2.51 2.77 2.94 3.17 ...

Source

Tong (1977). Journal of the Royal Statistical Society A, 432-436.

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(llynx)
```

`lynx` *Lynx data*

Description

The lynx data are the annual number of lynx trapped in the Mackenzie River district of Canada

Usage

```
data("lynx")
```

Format

The format is: Time-Series [1:114] from 1821 to 1934: 269 321 585 871 1475 ...

Source

Tong (1977). Journal of the Royal Statistical Society A, 432-436.

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(lynx)
```

ma.pred.wge *Predictive or rolling moving average*

Description

Given a time series in the vector x and order (either an odd or even integer) ma.pred.wge computes a predictive moving average giving 1-step ahead predictions through x(n+1). Optionally, you can specify k-step ahead forecasts beyond the end of the data.

Usage

```
ma.pred.wge(x,order=3,n.ahead=1,plot=TRUE)
```

Arguments

x	Vector containing original realization
order	Order (odd or even integer) of moving average predictor (default=3)
n.ahead	Number of steps ahead to forecast beyond the end of the data (default=1)
plot	If plot=TRUE then plots of the data and moving average predictors are plotted

Value

x	Original data
pred	Data file showing 1-step ahead predictors up to x(k.ahead)
order	Order (odd or even integer) of the moving average predictor

Author(s)

Wayne Woodward

References

"Practical Time Series Analysis with R" by Woodward, Sadler, and Robertson"

Examples

```
data(wtcrude)
sm=ma.pred.wge(x=wtcrude,order=5,n.ahead=10)
```

`ma.smooth.wge` *Centered Moving Average Smoother*

Description

Given a time series in the vector x and order (either an odd or even integer) ma.smooth.wge computes a centered moving average smoother and optionally plots the data and smoothed data

Usage

```
ma.smooth.wge(x,order=3,plot=TRUE)
```

Arguments

`x`	Vector containing original realization
`order`	Order (odd or even integer) of moving average smoother
`plot`	If plot=TRUE then plots of the data and smoothed data are plotted

Value

`x`	Original data
`smooth`	Data after application of centered average filter.l
`order`	Order (odd or even integer) of the smoother

Author(s)

Wayne Woodward

References

"Practical Time Series Analysis with R" by Woodward, Sadler, and Robertson"

Examples

```
data(wtcrude)
sm=ma.smooth.wge(x=wtcrude,order=5)
```

`ma2.table7.1` *Simulated MA(2) data*

Description

This realization is used to obtain the innovations estimates shown in Table 7.1

Usage

```
data("ma2.table7.1")
```

Format

The format is: num [1:400] 1.299 1.831 -0.162 -0.648 1.243 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(ma2.table7.1)
```

`macoef.geg.wge` *Calculate coefficients of the general linear process form of a Gegenbauer process*

Description

Calculate coefficients of the general linear process form of a Gegenbauer process based on formula (8), page 6 of Ferrara and Guegan(2001).

Usage

```
macoef.geg.wge(u, lambda, trun = 300000)
```

Arguments

`u`	The value of u in the Gegenbauer model
`lambda`	The value of lambda in the Gegenbauer model
`trun`	The truncation point of the infinite GLP form

Details

This function is called by gen.geg.wge

Value

A vector of length trun containing the GLP coefficients

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott and Ferrara and Guegan(2001)

Examples

```
mageg=macoef.geg.wge(u=.8,lambda=.3)
```

---

mass.mountain *Massachusettts Mountain Earthquake Data*

Description

Lg wave from from an earthquake known as Massachusetts Mountain Earthquake(5 August 1971), which was recorded at the Mina Nevada station

Usage

```
data("mass.mountain")
```

Format

The format is: num [1:454] -0.03655 -0.01774 0.00218 0.01193 0.00915 ...

Source

Gupta, Chan, and Wagner (2005). Regional sources discrimination of small events based on the use of Lg wavetrain, Bulletin of the Seismological Society of America 95, 341-346.

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(mass.mountain)
```

`MedDays` *Median days a house stayed on the market*

Description

Median days a house stayed on the market between July 2016 and April 2020

Usage

```
data("MedDays")
```

Format

ts object consisting of monthly data from July 2016 through April 2020

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(MedDays)
```

`mm.eq` *Massachusetts Mountain Earthquake data shown in Figure 13.13a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Lg wave for Massachusetts Mountain Earthquake

Usage

```
data("mm.eq")
```

Format

The format is: num [1:454] -0.03655 -0.01774 0.00218 0.01193 0.00915 ...

Source

Gupta, et al. (2005) Bulletin of the Seismological Society of America 95, 341-346.

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(mm.eq)
```

---

mult.wge *Multiply Factors*

Description

The function multiplies the AR (or MA) factors of a model to produce the model in unfactored form. Requires the CRAN package 'PolynomF'.

Usage

```
mult.wge(fac1 = 0, fac2 = 0, fac3 = 0, fac4 = 0, fac5 = 0, fac6 = 0)
```

Arguments

fac1	First factor to be multiplied
fac2	Second factor to be multiplied
fac3	Third factor to be multiplied (you may use a maximum of 6 factors)
fac4	Fourth factor to be multiplied (you may use a maximum of 6 factors)
fac5	Fifth factor to be multiplied (you may use a maximum of 6 factors)
fac6	Sixth factor to be multiplied (you may use a maximum of 6 factors)

Value

char.poly	The characteristics polynomial of the full model
model.coef	Model coefficients of the full model using notation in "Applied Time Series Analysis, 2nd edition" by Woodward, Gray, and Elliott

Note

Requires CRAN package 'PolynomF'

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
fac1=c(1.6,-.9)
fac2=.8
mult.wge(fac1,fac2)
```

`NAICS` *Monthly Retail Sales Data*

Description

Monthly sales for the North American Industry Classification System (NAICS) code 44X72: Retail Trade and Food Services: 1992-2019

Usage

```
data("NAICS")
```

Format

ts object consisting of monthly data from January 1992- December 2019

Source

https://www.weather.gov/fwd/dmotemp

References

"Kaggle" and "US Census Bureau" websites

Examples

```
data(NAICS)
```

`nbumps256` *256 noisy bumps signal*

Description

Noisy bumps signal shown in Figure 12.11(a) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Usage

```
data("nbumps256")
```

Format

The format is: num [1:256] -0.234 0.123 0.303 0.134 -0.513 ...

Source

Donoho and Johnstone(1994) Biometrika 81,425-455

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(nbumps256)
```

`nile.min` *Annual minimal water levels of Nile river*

Description

Water levels for 622 through 1284 measured at Roda gauge near Cairo (Tousson, 1925)

Usage

```
data("nile.min")
```

Format

The format is: Time-Series [1:663] from 622 to 1284: 1157 1088 1169 1169 984 ...

Source

Tousson, O. (1925) M\'emoire sur l'Histoire du Nil, Volume 18 in M\'emoires a l'Institut d'Egypte, pp. 366-404.

References

Beran, J. (1994) Statistics for Long-Memory Processes, Chapman Hall: Englewood, NJ.

Examples

```
data(nile.min)
```

`noctula` *Nyctalus noctula echolocation data*

Description

Echolocation signal for the Nyctalus noctula hunting bat

Usage

```
data("noctula")
```

Format

The format is: num [1:96] -18 16 -5 -17 21 -6 -17 20 -6 -16 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

`NSA` *Monthly Total Vehicle Sales*

Description

Monthly Total Vehicle Sales (TOTALNSA) in the United States from January 1976 - December 2019

Usage

```
data("NSA")
```

Format

ts object consisting of monthly data from January 1976- December 2019

Source

https://www.weather.gov/fwd/dmotemp

References

"Kaggle" and "US Census Bureau" websites

Examples

```
data(NSA)
```

---

ozona *Daily Number of Chicken-Fried Steaks Sold*

Description

Daily number of chicken-fried steaks sold at Ozona Bar and Grill during June and July 2019

Usage

```
data("ozona")
```

Format

ts object consisting of number of chicken fried steaks sold daily during June and July, 2019

Source

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(ozona)
```

---

pacfts.wge *Compute partial autocorrelations*

Description

Compute partial autocorrelations using either YW (default and the classical method), Burg, or ML estimates.)

Usage

```
pacfts.wge(x,lag.max=5, plot=TRUE,na.action,limits=FALSE,method ='yw')
```

Arguments

`x`	Realization
`lag.max`	Max lag
`plot`	Logical variable
`na.action`	Not used
`limits`	Logical variable
`method`	Either "mle" (default),"burg",or"yw"

Value

`method`	Estimation method used: MLE, Burg, or YW
`pacf`	PACF estimates using estimation method specified

Author(s)

Wayne Woodward

References

"Time Series for Data Science: Analysis and Forecasting with R" by Woodward, Sadler, and Gray

Examples

```
data(sunspot2.0)
         pacfts.wge(sunspot2.0,lag.max=10,method='burg')
```

`parzen.wge` *Smoothed Periodogram using Parzen Window*

Description

This function calculates and optionally plots the smoothed periodogram using the Parzen window. The truncation point may be chosen by the user

Usage

```
parzen.wge(x, dbcalc = "TRUE", trunc = 0, plot = "TRUE")
```

Arguments

`x`	Vector containing the time series realization
`dbcalc`	If dbcalc=TRUE, the calculation is in the log (dB) scale. If FALSE, then non-log calculations are made
`trunc`	if M=0 (default) then the function uses the truncation point 2*sqrt(n). If M>0, then the function uses the given value of M as the truncation point
`plot`	If PLOT=TRUE then the smoothed spectral estimate is plotted. If FALSE then no plot is created

Value

freq	The frequencies at which the smoothed periodogram is calculated
pzgram	The smoothed periodogram using the Parzen window

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
parzen.wge(rnorm(100))
```

---

patemp — *Pennsylvania average monthly temperatures*

Description

Pennsylvania average monthly temperatures

Usage

```
data("patemp")
```

Format

The format is: num [1:180] 38.1 38.3 44.5 52.3 59.2 70.6 73.9 71.3 63.9 57.3 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and elliott

Examples

```
data(patemp)
```

`period.wge` *Calculate the periodogram*

Description

Given a realization contained in a vector, this function calculates and optionally plots the periodogram in either log or non-log scale

Usage

```
period.wge(x, dbcalc = "TRUE", plot = "TRUE")
```

Arguments

`x`	The vector containing the time series realization
`dbcalc`	if dbcalc=TRUE (default) then the periodogram is calculated in log scale (in dB). If dbcalc is FALSE then the non-log periodogram is calculated
`plot`	if plot=TRUE (default) the periodogram is plotted. If plot=FALSE no plot is created

Value

`freq`	Frequencies at which the periodogram is calculated
`pgram`	Periodogram values evaluated at the frequencies in freq

Author(s)

Wayne Woodward

References

"Applied Time series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
period.wge(rnorm(100))
```

pi.weights.wge *Calculate pi weights for an ARMA model*

Description

Given the coefficients of the AR and MA parts of an ARMA model, this function calculates the pi weights

Usage

```
pi.weights.wge(phi = 0, theta = 0, lag.max =5)
```

Arguments

phi	Vector of AR coefficients (as in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott (uses Box and Jenkins notation))
theta	Vector of MA coefficients (as in ATSA and Box Jenkins texts)
lag.max	The function will calculates psi weights pi(1), pi(2), ..., pi(lag.max). Note that psi(0)=1.

Value

A vector containing pi(1), ..., pi(lag.max)

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
pi.weights.wge(phi=c(1.2,-.6), theta=.5, lag.max=5)
```

plotts.dwt.wge *Plots Discrete Wavelet Transform (DWT)*

Description

Plots DWT obtained using functiond dwt from waveslim

Usage

```
plotts.dwt.wge(x, n.levels, type='S8')
```

Arguments

x	Realization (must be of length 2^k for some integer k between 2 and 14
n.levels	Maximum order of discrete wavelet transforms to be calculated. n.levels must be less than or equal to k where n=2^k
type	Discrete wavelet to use: options include 'haar', 'S8','D4','D6',D8'

Details

The wavelsim dwt function names these :'haar', 'la8','d4','d6',and 'd8' respectively and the conversion is done transparently within the R code. This is done transparently within the R code.

Value

The output is a plot of the DWT.

Note

Requires CRAN package 'waveslim'

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(bumps256)
                  plotts.dwt.wge(bumps256,n.levels=4,type='S8')
```

plotts.mra.wge *Plots MRA plot)*

Description

Plots MAR ;plot associated with a multiresolution analysis using function mra from waveslim

Usage

```
plotts.mra.wge(x, n.levels, type='S8')
```

Arguments

x	Realization (must be of length 2^k for some integer k between 2 and 14
n.levels	Maximum order of discrete wavelet transforms to be calculated. n.levels must be less than or equal to k where n=2^k
type	Discrete wavelet to use: options include 'haar', 'S8','D4','D6',D8'

Details

The wavelsim mra function names these :'haar', 'la8','d4','d6',and 'd8' respectively and the conversion is done transparently within the R code. This is done transparently within the R code.

Value

The output is a plot of the MRA.

Note

Requires CRAN package 'waveslim'

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(bumps256)
                 plotts.mra.wge(bumps256,n.levels=4,type='S8')
```

plotts.parzen.wge	*Calculate and plot the periodogram and Parzen window estimates with differing trunctaion points*

Description

Given a time series contained in the vector x, plotsp.parzen.wge calculates and plots the periodogram and Parzen window estimates at the default truncation point M=2*sqrt(n) and up to 2 additional user specified trunctaion points.

Usage

```
plotts.parzen.wge(x, m2=c(0,0))
```

Arguments

x	The vector containing the time series realization
m2	A 2-component vector specifying up to 2 additional truncation points

Details

m2=c(10,24) indicates that in addition to the default truncation point, the smoothed spectral estimator is to be calculated using truncation points 10 and 24, m2=c(0,0) indicates that no additional truncation points are to be used, and m2=c(10,0) indicates the use of one additional truncation point (10)

Value

freq	Frequencies at which the periodogram and parzen widow estimates are calculated
db	Periodogram (in dB) calculated at the frequencies in freq
dbz	Parzen window estimate (in dB) calculated at the frequencies in freq using truncation point 2*sqrt(n)
dbz1	Parzen window estimate (in dB) calculated at the frequencies in freq using truncation point m2[1]
dbz2	Parzen window estimate (in dB) calculated at the frequencies in freq using truncation point m2[2]

Author(s)

Wayne Woodward

References

"Applied Time series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(ss08)
    m2=c(10,50)
    plotts.parzen.wge(ss08,m2)
```

`plotts.sample.wge` *Plot Data, Sample Autocorrelations, Periodogram, and Parzen Spectral Estimate*

Description

For a given realization, this function plots the data, and calculates and plots the sample autocorrelations, periodogram, and Parzen window spectral estimator in a 2x2 array of plots.

Usage

```
plotts.sample.wge(x, lag.max = 25, trunc = 0, arlimits=FALSE,speclimits=c(0,0),
periodogram=FALSE)
```

Arguments

`x`	A vector containing the realization
`lag.max`	The maximum lag at which to calculate the sample autocorrelations
`trunc`	The truncation point M for the Parzen spectral estimator. If M=0 theN M=2sqrt(n). If M>0 then M is the value entered
`arlimits`	Logical variable. TRUE plots 95 percent limit lines on sample autocorrelation plots
`periodogram`	Logical variable. TRUE plots periodogram, default=FALSE
`speclimits`	User supplied limits for Parzen spectral density and periodogram, default=function decides limits

Value

`xbar`	The sample mean of the realization
`autplt`	A vector containing sample autocorrelations from 0, 1, ..., aut.lag
`freq`	A vector containing the frequencies at which the periodogram and window estimate are calculated
`db`	Periodogram (in dB) calculated at the frequecies in freq
`freq`	Parzen spectral estimate (in dB) calculated at the frequecies in freq

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(wages)
plotts.sample.wge(wages,trunc=0)
```

---

plotts.true.wge *Plot of generated data, true autocorrelations and true spectral density for ARMA model*

Description

For a given ARMA model, this function plots a realization, the true autocorrelations, and the true spectral density. This plot is typical of many plots in Applied Time Series Analysis by Woodward, Gray, and Elliott. For example, see Figure 1.21 and Figure 3.23.

Usage

```
plotts.true.wge(n=100, phi=0, theta=0, lag.max=25, mu=0,vara = 1,sn=0,plot.data=TRUE)
```

Arguments

n	Length of time series realization to be generated. Default is 100
phi	Vector containing AR parameters
theta	Vector containing MA parameters
lag.max	Maximum lag for calculating and plotting autocorrelations
mu	True mean
vara	White noise variance: default=1
sn	determines the seed used in the simulation of plotted realization. sn=0 produces new/random realization each time. sn=positive integer produces same realization each time
plot.data	Logical variable: If TRUE a simulated realization is plotted

Value

data	Realization of length n that is generated from the ARMA model
aut1	True autocorrelations from the ARMA model for lags 0 to lag.max
acv	True autocovariances from the ARMA model for lags 0 to lag.max
spec	Spectral density (in dB) for the ARMA model calculated at frequencies f=0, .002, .004, ..., .5

Note

gvar=g[1], i.e. autocovariance at lag 0

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
plotts.true.wge(n=100, phi=c(1.6,-.9), theta=.8, lag.max=25, vara = 1)
```

`plotts.wge` *Plot a time series realization*

Description

Given a realization contained in a vector, this function plots it as a time series realization

Usage

```
plotts.wge(x,style = 0, xlab = "Time", ylab = "",main="",col='black',text_size=12,
lwd=0.75,cex=0.5,cex.lab=0.75,cex.axis=0.75,xlim=NULL,ylim=NULL)
```

Arguments

`x`	The vector containing the time series realization to be plotted
`style`	If style is 0 then a simple plot of the realization is rendered. If style is 1 then a ggplot is rendered.
`xlab`	A string that represents the x-axis label.
`ylab`	A string that represents the y-axis label.
`main`	A string that represents the main title.
`col`	Color of plot.
`text_size`	Text size.
`lwd`	Line width.
`cex`	See R documentation.
`cex.lab`	See R documentation.
`cex.axis`	See R documentation.
`xlim`	String giving x-axis plot limits.
`ylim`	String giving y-axis plot limits.

Value

Simply a plot of the realization

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(sunspot2.0);plotts.wge(sunspot2.0)
```

`prob10.4` *Data matrix for Problem 10.4 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

Matrix containing a bivariate VAR data set

Usage

```
data("prob10.4")
```

Format

The format is: num [1:100, 1:2] 0 0.7184 -0.3448 -2.1638 -0.0342 ... - attr(*, "dimnames")=List of 2 ..$: NULL ..$: chr [1:2] "X1" "X2"

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob10.4)
```

`prob10.6x` *Data for Problem 10.6 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

This realization is the unobservable data associated with the observed data in prob10.6y

Usage

```
data("prob10.6x")
```

Format

The format is: num [1:9] 2.61 0.69 0.64 0.37 -0.79 -1.63 -1.14 -1.2 -3.13

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob10.6x)
```

`prob10.6y` *Simulated observed data for Problem 10.6 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Kalman filter example data

Usage

```
data("prob10.6y")
```

Format

The format is: num [1:9] 3.28 -0.05 0.64 0.31 -0.9 -2.4 -1.83 -1.93 -3.52

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob10.6y)
```

---

prob10.7x	*Data for Problem 10.7 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

This realization is the same unobservable data as in prob10.6x

Usage

```
data("prob10.7x")
```

Format

The format is: num [1:9] 2.61 0.69 0.64 0.37 -0.79 -1.63 -1.14 -1.2 -3.13

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob10.7x)
```

`prob10.7y` *Simulated observed data for Problem 10.6 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Kalman filter example data

Usage

```
data("prob10.7y")
```

Format

The format is: num [1:9] 3.28 -0.05 0.64 0.31 -0.9 -2.4 -1.83 -1.93 -3.52

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob10.7y)
```

`prob11.5` *Data for Problem 11.5 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated fractional long memory data

Usage

```
data("prob11.5")
```

Format

The format is: num [1:10] 4.2 -2.5 8.4 14.6 7 9.6 19.8 4.8 6.5 8.3

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob11.5)
```

---

prob12.1c *Data for Problem 12.1c and 12.3c in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Data from a problem set in the wavelet chapter

Usage

```
data("prob12.1c")
```

Format

The format is: num [1:200] 9.49 8.01 3.43 -1.85 -4.99 -7.21 -5.61 -2.34 2.16 3.88 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob12.1c)
```

prob12.3a — *Data for Problem 12.3a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Data from a problem set in the wavelet chapter

Usage

```
data("prob12.3a")
```

Format

The format is: num [1:512] -3.09 8.43 -9.74 8.44 -3.46 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob12.3a)
```

prob12.3b — *Data for Problem 12.3b in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Data from a problem set in the wavelet chapter

Usage

```
data("prob12.3b")
```

Format

The format is: num [1:256] 1 1 1 1 1 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob12.3b)
```

---

prob12.6c *Data set for Problem 12.6(C) in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated TVF data set

Usage

```
data("prob12.6c")
```

Format

The format is: num [1:512] -0.482 -0.569 -0.656 -0.743 -0.83 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob12.6c)
```

`prob13.2` *Data for Problem 13.2 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Simulated data from cosine-plus-noise model

Usage

```
data("prob13.2")
```

Format

The format is: num [1:256] 1.524 5.886 5.939 4.319 0.573 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(prob13.2)
```

`prob8.1a` *Data for Problem 8.1 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

See title above

Usage

```
data("prob8.1a")
```

Format

The format is: num [1:200] 2.19 0.48 0.06 3.86 3.6 -3.38 6.23 1.95 1.4 -5.35 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob8.1a)
```

`prob8.1b` *Data for Problem 8.1 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

See title above

Usage

```
data("prob8.1b")
```

Format

The format is: num [1:200] 1.54 -0.13 1.93 0.29 -0.13 -0.23 1.27 1.01 -0.65 1.68 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob8.1b)
```

`prob8.1c` *Data for Problem 8.1 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

See title above

Usage

```
data("prob8.1c")
```

Format

The format is: num [1:200] 0.33 -0.53 -2.36 2.48 -0.36 -2.02 1.87 -0.73 0.41 2.41 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob8.1c)
```

`prob8.1d` *Data for Problem 8.1 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott*

Description

See title above

Usage

```
data("prob8.1d")
```

Format

The format is: num [1:200] -0.07 -1.74 -1.37 -0.52 0.14 0.07 -1.5 1.88 -0.03 -1.81 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob8.1d)
```

---

prob9.6c1 *Data set 1 for Problem 6.1c*

Description

Data set 1 for Problem 6.1c in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott. It is either from line plus noise or random walk with drift.

Usage

```
data("prob9.6c1")
```

Format

The format is: num [1:100] -0.2924 0.0206 0.6595 0.3819 0.0269 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob9.6c1)
```

`prob9.6c2` *Data set 2 for Problem 6.1c*

Description

Data set 2 for Problem 6.1c in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott. It is either from line plus noise or random walk with drift.

Usage

```
data("prob9.6c2")
```

Format

The format is: num [1:100] -0.925 -2.679 -2.378 -3.03 -2.157 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott.

Examples

```
data(prob9.6c2)
```

`prob9.6c3` *Data set 3 for Problem 6.1c*

Description

Data set 3 for Problem 6.1c in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott. It is either from line plus noise or random walk with drift.

Usage

```
data("prob9.6c3")
```

Format

The format is: num [1:100] -2.79 -3.32 -3.51 -5.13 -3.51 ...

Source

Simulated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob9.6c3)
```

---

prob9.6c4 *Data set 4 for Problem 6.1c*

Description

Data set 4 for Problem 6.1c in "Applied Time Series and Data Analysis with R, 2nd edition" by Woodward, Gray, and Elliott. It is either from line plus noise or random walk with drift.

Usage

```
data("prob9.6c4")
```

Format

The format is: num [1:100] -0.0599 -0.0214 0.6589 -0.151 0.4043 ...

Source

Simulated data

References

"Applied Time Series and Data Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(prob9.6c4)
```

psi.weights.wge *Calculate psi weights for an ARMA model*

Description

Given the coefficients of the AR and MA parts of an ARMA model, this function calculates the psi weights

Usage

```
psi.weights.wge(phi = 0, theta = 0, lag.max = 5)
```

Arguments

phi	Vector of AR coefficients (as in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott (uses Box and Jenkins notation))
theta	Vector of MA coefficients (as in ATSA and Box Jenkins texts)
lag.max	The function will calculates psi weights psi(1), psi(2), ..., psi(lag.max). Note that psi(0)=1.

Value

A vector containing psi(1), ..., psi(lag.max)

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
psi.weights.wge(phi=c(1.2,-.6), theta=.5, lag.max=5)
```

rate *Daily DOW rate of Return*

Description

Daily DOW rate of return from 1971 through 2020

Usage

```
data("rate")
```

Format

ts object consisting of daily dow rate of return from 1971 through 2020

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(rate)
```

roll.win.rmse.nn.wge *Function to Calculate the Rolling Window RMSE*

Description

This function creates as many "windows" as is possible with the data and calculates an RMSE for each window. The resulting "rolling window RMSE" is the average of the individual RMSEs from each window.

Usage

```
roll.win.rmse.nn.wge(series, horizon = 1, fit_model)
```

Arguments

series	The data
horizon	The number of observations ahead to be forecasted.
fit_model	The mlp object (model) to be evaluated. This model will have been fit before the call to this function.

Value

`rwRMSE`	The average of the individual RMSEs of each window
`numwindows`	The number of windows
`horizon`	The number of observations ahead to be forecasted.

Author(s)

Bivin Sadler

References

"The Time Series Tool Kit"

`roll.win.rmse.wge` *Function to Calculate the Rolling Window RMSE*

Description

This function creates as many "windows" as is possible with the data and calculates an RMSE for each window. The resulting "rolling window RMSE" is the average of the individual RMSEs from each window.

Usage

```
roll.win.rmse.wge(series, horizon = 2, s = 0, d = 0, phi = 0, theta = 0)
```

Arguments

`series`	The data
`horizon`	The number of observations ahead to be forecasted.
`s`	Order of the seasonal difference, default=1
`d`	Order of the difference
`phi`	Vector of AR coefficients
`theta`	Vector of MA coefficients

Value

`rwRMSE`	The average of the individual RMSEs of each window
`numwindows`	The number of windows
`horizon`	The number of observations ahead to be forecasted.
`s`	Order of the seasonal difference, default=1
`d`	Order of the difference
`phis`	Vector of AR coefficients
`thetas`	Vector of MA coefficients
`RMSEs`	Vector of RMSEs ... one for each windwow

Author(s)

Bivin Sadler

References

"The Time Series Tool Kit"

`slr.wge` *Simple Linear Regression*

Description

Uses Base R routine lm to simplify call for SLR where independent variable is automatocally t=1:n

Usage

```
slr.wge(x)
```

Arguments

`x`	The TVF data set

Value

`res`	Residuals
`b0hat`	Estimate b0 in model y=b0+b1*t+Z
`b1hat`	Estimate b1
`pvalue`	pvalue for test:slope=0
`tstatistic`	tstatistic associated with test:slope=0

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
x=gen.arma.wge(n=100,phi=.96,sn=10)
                 y=slr.wge(x)
```

ss08 *Sunspot Data*

Description

Annual average sunspot numbers for the years 1749-2008

Usage

```
data("ss08")
```

Format

The format is: num [1:260] 80.9 83.4 47.7 47.8 30.7 ...

Source

Internet-open source

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(ss08)
```

ss08.1850 *Sunspot data from 1850 through 2008 for matching with global temperature data (hadley)*

Description

Sunspot data from 1850 through 2008 for matching with global temperature data (hadley) for purposes of testing for association in Example 10.5 of "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Usage

```
data("ss08.1850")
```

Format

The format is: num [1:160] 66.6 64.5 54.1 39 20.6 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(ss08.1850)
```

`starwort.ex` *Starwort Explosion data shown in Figure 13.13a in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

Lg wave for Starwort explosion data

Usage

```
data("starwort.ex")
```

Format

The format is: num [1:420] 43245 48408 47565 7372 -62277 ...

Source

Gupta, et al. (2005) Bulletin of the Seismological Society of America 95, 341-346.

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(starwort.ex)
```

`sunspot.classic` *Classic Sunspot Data: 1749-1924*

Description

The classic 176 point sunspot data from 1749-1924 that has been widely modeled

Usage

```
data("sunspot.classic")
```

Format

The format is: num [1:176] 80.9 83.4 47.7 47.8 30.7 12.2 9.6 10.2 32.4 47.6 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(sunspot.classic)
```

`sunspot2.0` *Annual Sunspot2.0 Numbers*

Description

Annual sunspot2.0 numbers from 1700 through 2020

Usage

```
data("sunspot2.0")
```

Format

ts object consisting of annual data from 1700 through 2020

Source

https://www.sidc.oma.be/silso

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(sunspot2.0)
```

`sunspot2.0.month` *Monthly Sunspot2.0 Numbers*

Description

Monthly sunspot2.0 numbers from January 1749 through December 2020

Usage

```
data("sunspot2.0.month")
```

Format

ts object consisting of monthly data from January 1749 through December 2020

Source

https://www.sidc.oma.be/silso

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(sunspot2.0.month)
```

`table10.1.noise` *Noise related to data set, the first 5 points of which are shown in Table 10.1 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

The data in Table 10.1 are of the form Y(t)=X(t)+n(t). This data set contains the values for n(t).

Usage

```
data("table10.1.noise")
```

Format

The format is: num [1:75] -0.49 0.126 -0.129 -1.179 0.441 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(table10.1.noise)
```

`table10.1.signal` *Underlying, unobservable signal (X(t), the first 5 points of which are shown in Table 10.1 in Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott*

Description

The X(t) data is unobservable, and is a realization from an AR(1) model

Usage

```
data("table10.1.signal")
```

Format

The format is: num [1:75] -0.2497 -0.0812 -0.6463 -1.7653 -2.719 ...

Source

Simulated data

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(table10.1.signal)
```

---

table7.1 *MA(2) data for Table 7.1*

Description

MA(2) data for Table 7.1 in "Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott. Uses function ia in package itsmr to show steps in the innovations algorithm for estimating the MA parameters and white noise variance

Usage

```
data("table7.1")
```

Format

The format is: num [1:400] 0.4481 0.5497 -1.6586 -3.1653 -0.0314 ...

Source

Generated data

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(table7.1)
```

---

tesla *Tesla Stock Prices*

Description

Teslas daily stock prices from January 1, 2020 through April 30, 2021

Usage

```
data("tesla")
```

Format

ts object consisting of daily adjusted close price for TSLA from January 1, 2020 through April 30, 2021

Source

https://finance.yahoo.com

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(tesla)
```

---

trans.to.dual.wge *Transforms TVF data set to a dual data set*

Description

Using the specified values for lambda and offset, this function transforms a TVF data set to a dual data set based on a Glambda time transformation.

Usage

```
trans.to.dual.wge(x, lambda, offset = 60, h = 0, plot = TRUE)
```

Arguments

x	The TVF data set
lambda	The value of lambda in the Glambda time transformation
offset	The value of offset in the Glambda time transformation
h	Scaling variable, initialized at zero, which assures that the dual data set has the same number of points as the original TVF data set
plot	Logical: TRUE=plot, FALSE=no plot

Value

intX	See intY description
intY	The input realization x is of length n, and the values of x are available at the time points t= 1 to n. The values intY are n interpolated values of the original time series at the values of intX in the original time scale. The dual data set is obtained by associating the n values of intY with t = 1 to n respectively
h	The output value of the scaling parameter that assures that the dual realization and the original realization are of the same length

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig13.2c)
                    y=trans.to.dual.wge(x=fig13.2c,lambda=-.4,offset=63)
```

---

trans.to.original.wge *Transforms dual data set back to original time scale*

Description

Using the specified values for lambda and offset, this function transforms a dual data set, based on a Glambda time transformation, back to the original time scale

Usage

```
trans.to.original.wge(xd, lambda, offset, h, plot = TRUE)
```

Arguments

xd	The dual data set
lambda	The value of lambda in the Glambda time transformation
offset	The value of offset in the Glambda time transformation
h	Scaling variable obtained as output from transform.to.dual.wge that assures that the dual data set has the same number of points as the origuinal TVF data set
plot	Logical: TRUE=plot, FALSE=no plot

Value

Returns the y values to be plotted at time points t=1 to n that approximate the original TVF data set

Author(s)

Wayne Woodward

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(fig13.2c)
                        yd=trans.to.dual.wge(fig13.2c,lambda=-.4,offset=63)
                        yo=trans.to.original.wge(yd$intY,lambda=-.4,offset=63,h=yd$h)
```

`true.arma.aut.wge` *True ARMA autocorrelations*

Description

R function to calculate the autocovariances and autocorrelations and optionally plot the true autocorrelations of a stationary ARMA model

Usage

```
true.arma.aut.wge(phi = 0, theta = 0, lag.max = 25, vara = 1,plot=TRUE)
```

Arguments

`phi`	Vector containing AR coefficients
`theta`	Vector containing MA coefficients
`lag.max`	Maximum lag at which to calculate the true autocorrelations
`vara`	White noise variance of the ARMA model
`plot`	Logical: TRUE=plot, FALSE=no plot

Value

`acf`	Vector of length max.lag+1 containing true autocorrelations at lags 0, 1, ..., lag.max
`acv`	Vector of length max.lag+1 containing true autocovariances at lags 0, 1, ..., lag.max

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
true.arma.aut.wge(phi=c(1.6,-.9),theta=-.8,lag.max=15,vara=1)
```

---

true.arma.spec.wge *True ARMA Spectral Density*

Description

R function to calculate and optionally plot the spectral density of a stationary ARMA model

Usage

```
true.arma.spec.wge(phi=0,theta=0, vara=1,plot=TRUE)
```

Arguments

phi	Vector containing AR coefficients
theta	Vector containing MA coefficients
vara	White noise variance of the ARMA model
plot	Logical: TRUE=plot, FALSE=no plot

Value

f	Frequencies at which true spectral density is evaluated: 0, 1/500, 2/500, ..., .5
spec	True spectral density calculated at the frequencies in f

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
true.arma.spec.wge(phi=c(1.6,-.9), theta=.7)
```

true.farma.aut.wge *True FARMA autocorrelations*

Description

Calculate the autocovariances and autocorrelations and optionally plot the true autocorrlations of a FARMA model

Usage

```
true.farma.aut.wge(d,phi=0,theta=0,lag.max=50,trunc=1000,vara=1,plot=TRUE)
```

Arguments

d	Fractional difference parameter
phi	vector of AR parameters of ARMA part of FARMA model
theta	vector of MA parameters of ARMA part of FARMA model using signs as given in the Woodward, Gray, and Elliott text
lag.max	Maximum lag at which the autocorrelations and autocovariances will be calculated
trunc	Number of terms used in sum
vara	White noise variance
plot	Logical: TRUE=plot, FALSE=no plot

Details

For fractional model use phi=theta=0

Value

acf	Vector of length max.lag+1 containing true autocorrelations at lags 0, 1, ..., lag.max
acv	Vector of length max.lag+1 containing true autocovariances at lags 0, 1, ..., lag.max

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, second editon" by Woodward, Gray, and Elliott

Examples

```
y=true.farma.aut.wge(d=.4,phi=c(0,-.8))
```

true.garma.aut.wge *True GARMA autocorrelations*

Description

Calculate the autocovariances and autocorrelations and optionally plot the true autocorrelations of a 1-factor based on formula(11.25) of "Applied Time Series Analysis with R, second editon" Woodward, Gray, and Elliott

Usage

```
true.garma.aut.wge(u,lambda,phi=0,theta=0,lag.max=50,vara=1,plot=TRUE)
```

Arguments

`u`	Parameter u in the GARMA model given in (11.16) of Woodward, Gray, and Elliott text
`lambda`	Parameter lambda in the GARMA model given in (11.16) of Woodward, Gray, and Elliott text
`phi`	vector of AR parameters of ARMA part of GARMA model
`theta`	vector of MA parameters of ARMA part of GARMA model using signs as given in the Woodward, Gray, and Elliott text
`lag.max`	Maximum lag at which the autocorrelations and autocovariances will be calculated
`vara`	White noise variance
`plot`	Logical: TRUE=plot, FALSE=no plot

Details

For Gegenbauer model use phi=theta=0

Value

`acf`	Vector of length max.lag+1 containing true autocorrelations at lags 0, 1, ..., lag.max
`acv`	Vector of length max.lag+1 containing true autocovariances at lags 0, 1, ..., lag.max

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, second editon" by Woodward, Gray, and Elliott

Examples

```
y=true.garma.aut.wge(u=.8,lambda=.4,phi=.8)
```

---

tx.unemp.adj *Texas Seasonally Adjusted Unnemployment Rates*

Description

Monthly seasonally adjusted unemployment rate in Texas for the years 2000-2019

Usage

```
data("tx.unemp.adj")
```

Format

ts object consisting of monthly seasonally adjusted unemployment rate from January 2000 through December 2019

Source

https://twc.texas.gov

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(tx.unemp.adj)
```

---

tx.unemp.unadj *Texas Unadjusted Unnemployment Rates*

Description

Monthly unemployment rate in Texas for the years 2000-2019

Usage

```
data("tx.unemp.unadj")
```

Format

ts object consisting of monthly unadjusted unemployment rate from January 2000 through December 2019

Source

https://twc.texas.gov

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(tx.unemp.unadj)
```

---

unit.circle.wge *Plot the roots of the characteristic equation on the complex plain.*

Description

This function plots the roots of the characteristic equation on the complex plain and super imposes the Unit Circle to show if a root is inside, outside or on the Unit Circle. The modulus and absolule reciprical are also displayed.

Usage

```
unit.circle.wge(real = 0, imaginary = 0)
```

Arguments

`real`	the real part of the root
`imaginary`	the imaginary part of the root

Value

returns a plot of the root with respect to the unit circle

Author(s)

Bivin Sadler

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
unit.circle.wge = function(real = .9, imaginary = .95)
```

us.retail *Quarterly US Retail Sales*

Description

Quarterly US retail sales (in $millions) from the fourth quarter of 1999 through the second quarter of 2021

Usage

```
data("us.retail")
```

Format

ts object consisting of quarterly US retail sales (in $millions) from the fourth quarter of 1999 through the second quarter of 2021

Source

https://www.fred.stlouis.org

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(us.retail)
```

uspop *US population*

Description

US estimated annual population from 1900 through 2020.

Usage

```
data("uspop")
```

Format

ts object consisting of annual data from 1700 through 2020

Source

Internet

References

"Time Series for Data Science: Analysis and Forecasting" by Woodward, Sadler, and Robertson

---

wages *Daily wages in Pounds from 1260 to 1944 for England*

Description

This data set contains the average English daily wages in pounds for each year from 1260 to 1944, inclusive.

Usage

```
data("wages")
```

Format

The format is: num [1:735] 4.41 4.63 4.38 4.52 4.42 4.64 4.44 5.15 5.23 4.42 ...

Source

Data Market Time Series Data Library (citing: Makridakis, Wheelwright and Hyndman (1998))

Examples

```
data(wages)
```

---

wbg.boot.wge *Woodward-Bottone-Gray test for trend*

Description

Performs the Woodward-Bottone-Gray (WBG) bootstrap-based test for a linear trend in a time series realization.)

Usage

```
wbg.boot.wge(x,nb=399,alpha=.05,pvalue=TRUE,sn=0)
```

Arguments

x	Realization
nb	The number of Bootstrap replications (default is 399)
alpha	The significance level of the test (default is .05)
pvalue	Logical variable. TRUE(default) prints out the p-value of the test.
sn	Sets the seed for the simulations (default = 0))

Value

p	AR order used for the bootstrap simulations
phi	The AR coefficients of the AR model fit to data
pv	The p-value of the test

Author(s)

Wayne Woodward

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

Examples

```
data(global.temp)
          wbg.boot.wge(global.temp)
```

`whale` *Whale click data*

Description

256 point whale click echolocation signal

Usage

```
data("whale")
```

Format

The format is: num [1:286] 0.0014 -0.008 0.01126 0.00412 0.0069 ...

Source

Stan Kuczaj from University of Southern Mississippi

References

Applied Time Series Analysis with R, second edition by Woodward, Gray, and Elliott

Examples

```
data(whale)
```

`wtcrude` *West Texas Intermediate Crude Oil Prices*

Description

Monthly West Texas intermediate crude oil prices from January 2000 through October 2009.

Usage

```
data("wtcrude")
```

Format

The format is: num [1:118] 27.2 29.4 29.9 25.7 28.8 ...

Source

Internet

References

"Applied Time Series Analysis with R, 2nd edition" by Woodward, Gray, and Elliott

`wtcrude2020` *Monthly WTI Crude Oil Prices*

Description

Monthly WTI crude oil prices from January 1990 through December 2020

Usage

```
data("wtcrude2020")
```

Format

ts object consisting of monthly data from January 1990 through December 2020

Source

https://fred.stlouis.org

References

"Time Series for Data Sience: Analysis and Forecasting" by Woodward, Sadler, and Robertson

Examples

```
data(wtcrude2020)
```

wv.wge — *Function to calculate Wigner Ville spectrum*

Description

Calculates and plots Wigner-Ville spectrum for a realization

Usage

```
wv.wge(x)
```

Arguments

x	Realization to be analyzed

Value

Plots Wigner-Ville spectrum

Author(s)

Wayne Woodward

References

Boashash (2003). Time Frequency Analysis

Examples

```
data(doppler)
wv.dop=wv.wge(doppler)
```

yellowcab.precleaned — *Precleaned Yellow Cab data*

Description

The number of Yellow Cab Trips in NYC before and during the COVID outbreak: January 2019 through February 2021

Usage

```
data("yellowcab.precleaned")
```

Format

The format is: Time-Series [1:26] from 2019 to 2021: 247315 250654 252634 247742 ...

Source

NYC Taxi and Limousine website

References

Time Series for Data Science Woodward, Sadler, and Robertson

Examples

```
data(yellowcab.precleaned)
```

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