Package 'astsa'

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Type Package

Title Applied Statistical Time Series Analysis

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Author David Stoffer

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Description Included are data sets and scripts to accompany Time Series Analysis and Its Application: With R Examples (4th ed), by R.H. Shumway and D.S. Stoffer. Springer Texts in Statistics, 2017. <DOI:10.1007/978-3-319-52452-8>.

URL http://www.stat.pitt.edu/stoffer/tsa4/

   https://github.com/nickpoison/astsa

License GPL (>= 2)

LazyLoad yes

LazyData yes

NeedsCompilation no

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R topics documented:

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astsa-package	*Applied Statistical Time Series Analysis*

Description

Includes data and scripts to accompany *Time Series Analysis and Its Applications: With R Examples* (4th ed) by R.H. Shumway and D.S. Stoffer. Springer Texts in Statistics, 2017. <DOI:10.1007/978-3-319-52452-8>.

Details

Package:	astsa
Type:	Package
Version:	1.8
Date:	2017-12-13
License:	GPL (>= 2)
LazyLoad:	yes
LazyData:	yes

Note

This is most likely the last version of the package that I will submit to CRAN... I can NOT deal with these crazy people any more. However, the most recent working version of the package will always be on GitHub. See https://github.com/nickpoison/astsa for details.

Author(s)

David Stoffer <stoffer@pitt.edu>

References

See the webpage for the text: http://www.stat.pitt.edu/stoffer/tsa4/

---

acf1   *Plot and print ACF of a time series*

Description

Produces a plot (and a printout) of the sample ACF. The zero lag value of the ACF is removed.

Usage

```
acf1(series, max.lag=NULL, main=paste("Series: ", deparse(substitute(series))),
    na.action = na.pass, ...)
```

Arguments

series	The data. Does not have to be a time series object.
max.lag	Maximum lag. Can be omitted. Defaults to $\sqrt{n}+10$ unless $n < 60$. If the series is seasonal, this will be at least 4 seasons by default.
main	Title of graphic; defaults to name of series.
na.action	How to handle missing data; default is na.pass
...	Additional arguments passed to acf

Details

This is basically a wrapper for acf() provided in tseries. The zero lag (which is always 1) has been removed. The error bounds are approximate white noise bounds, $0 \pm 2/\sqrt{n}$; no other option is given.

Value

ACF	The sample ACF

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
acf1(rnorm(100))
acf1(rnorm(100), 25, main='')  # no title
```

---

acf2   *Plot and print ACF and PACF of a time series*

Description

Produces a simultaneous plot (and a printout) of the sample ACF and PACF on the same scale. The
zero lag value of the ACF is removed.

Usage

```
acf2(series, max.lag=NULL, plot=TRUE,
      main=paste("Series: ", deparse(substitute(series))),
      na.action = na.pass, ...)
```

Arguments

series	The data. Does not have to be a time series object.
max.lag	Maximum lag. Can be omitted. Defaults to $\sqrt{n}+10$ unless $n < 60$. If the series is seasonal, this will be at least 4 seasons by default.
plot	If FALSE, no graph is produced but the values are still printed.
main	Title of graphic; defaults to name of series.
na.action	How to handle missing data; default is na.pass
...	Additional arguments passed to acf

Details

This is basically a wrapper for acf() provided in tseries. The error bounds are approximate white
noise bounds, $0 \pm 2/\sqrt{n}$; no other option is given.

Value

ACF	The sample ACF
PACF	The sample PACF

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
acf2(rnorm(100))
acf2(rnorm(100), 25, main='')  # no title
acf2(rnorm(100), plot=FALSE)[,'ACF']  # print only ACF
```

---

ar1miss	*AR with Missing Values*

Description

Data used in Chapter 6

Format

The format is: Time-Series [1:100] with NA for missing values.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

arf	*Simulated ARFIMA*

Description

1000 simulated observations from an ARFIMA(1, 1, 0) model with $\phi = .75$ and $d = .4$.

Format

The format is: Time-Series [1:1000] from 1 to 1000: -0.0294 0.7487 -0.3386 -1.0332 -0.2627 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

arma.spec   *Spectral Density of an ARMA Model*

Description

Gives the ARMA spectrum (on a log scale), tests for causality, invertibility, and common zeros.

Usage

```
arma.spec(ar = 0, ma = 0, var.noise = 1, n.freq = 500, ...)
```

Arguments

`ar`	vector of AR parameters
`ma`	vector of MA parameters
`var.noise`	variance of the noise
`n.freq`	number of frequencies
`...`	additional arguments

Details

The basic call is `arma.spec(ar, ma)` where `ar` and `ma` are vectors containing the model parameters. Use `log="no"` if you do not want the plot on a log scale. If the model is not causal or invertible an error message is given. If there are common zeros, a spectrum will be displayed and a warning will be given; e.g., `arma.spec(ar= .9, ma= -.9)` will yield a warning and the plot will be the spectrum of white noise.

Value

`freq`	frequencies - returned invisibly
`spec`	spectral ordinates - returned invisibly

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
arma.spec(ar = c(1, -.9), ma = .8, log="no")
```

ARMAtoAR   *Convert ARMA Process to Infinite AR Process*

Description

Gives the π-weights in the invertible representation of an ARMA model.

Usage

```
ARMAtoAR(ar = 0, ma = 0, lag.max=20)
```

Arguments

ar   vector of AR coefficients

ma   vector of MA coefficients

lag.max   number of pi-weights desired

Value

A vector of coefficients.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
# From Section 3.1
ARMAtoAR(ar=.9, ma=.5, 10)
```

---

beamd   *Infrasonic Signal from a Nuclear Explosion*

Description

Infrasonic signal from a nuclear explosion.

Usage

```
data(beamd)
```

Format

A data frame with 2048 observations (rows) on 3 numeric variables (columns): sensor1, sensor2, sensor3.

Details

This is a data frame consisting of three columns (that are not time series objects). The data are an infrasonic signal from a nuclear explosion observed at sensors on a triangular array.

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

birth	*U.S. Monthly Live Births*

Description

Monthly live births (adjusted) in thousands for the United States, 1948-1979.

Format

The format is: Time-Series [1:373] from 1948 to 1979: 295 286 300 278 272 268 308 321 313 308 ...

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

blood	*Daily Blood Work*

Description

Multiple time series of measurements made for 91 days on the three variables, log(white blood count) [WBC], log(platelet) [PLT] and hematocrit [HCT]. Missing data code is NA.

Format

The format is: mts [1:91, 1:3]

Details

This is the data set used in Chapter 6 with NA as the missing data code.

Source

Jones, R.H. (1984). Fitting multivariate models to unequally spaced data. In *Time Series Analysis of Irregularly Observed Data*, pp. 158-188. E. Parzen, ed. Lecture Notes in Statistics, 25, New York: Springer-Verlag.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[HCT](#), [PLT](#), [WBC](#)

Examples

```
## Not run:  plot(blood, type="o", pch=19)
```

---

bnrf1ebv   *Nucleotide sequence - BNRF1 Epstein-Barr*

Description

Nucleotide sequence of the BNRF1 gene of the Epstein-Barr virus (EBV): 1=A, 2=C, 3=G, 4=T. The data are used in Chapter 7.

Format

The format is: Time-Series [1:3954] from 1 to 3954: 1 4 3 3 1 1 3 1 3 1 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

bnrf1hvs   *Nucleotide sequence - BNRF1 of Herpesvirus saimiri*

Description

Nucleotide sequence of the BNRF1 gene of the herpesvirus saimiri (HVS): 1=A, 2=C, 3=G, 4=T. The data are used in Chapter 7.

Format

The format is: Time-Series [1:3741] from 1 to 3741: 1 4 3 2 4 4 3 4 4 4 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

ccf2 *Cross Correlation Plot*

Description

Produces a nice graphic (and only a plot) of the sample CCF of two time series.

Usage

```
ccf2(x, y, max.lag = NULL, main=NULL, ylab="CCF", na.action = na.pass, ... )
```

Arguments

x, y	univariate time series.
max.lag	maximum lag for which to calculate the CCF.
main	plot title - if NULL, uses x and y names.
ylab	vertical axis label; default is 'CCF'.
na.action	how to handle missing values; default is na.pass
...	additional arguments passed to acf

Details

This will produce a graphic of the sample corr[x(t+lag), y(t)] from -max.lag to max.lag.

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

chicken *Monthly price of a pound of chicken*

Description

Poultry (chicken), Whole bird spot price, Georgia docks, US cents per pound

Usage

```
data("chicken")
```

Format

The format is: Time-Series [1:180] from August 2001 to July 2016: 65.6 66.5 65.7 64.3 63.2 ...

Source

<http://www.indexmundi.com/commodities/>

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

climhyd   *Lake Shasta inflow data*

Description

Lake Shasta inflow data This is a data frame.

Format

A data frame with 454 observations (rows) on the following 6 numeric variables (columns): `Temp`, `DewPt`, `CldCvr`, `WndSpd`, `Precip`, `Inflow`.

Details

The data are 454 months of measured values for the climatic variables: air temperature, dew point, cloud cover, wind speed, precipitation, and inflow, at Lake Shasta, California. The man-made lake is famous for the placard stating, "We don't swim in your toilet, so don't pee in our lake."

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

cmort   *Cardiovascular Mortality from the LA Pollution study*

Description

Average weekly cardiovascular mortality in Los Angeles County; 508 six-day smoothed averages obtained by filtering daily values over the 10 year period 1970-1979.

Format

The format is: Time-Series [1:508] from 1970 to 1980: 97.8 104.6 94.4 98 95.8 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[lap](#)

---

cpg	*Hard Drive Cost per GB*

Description

Median annual cost per gigabyte (GB) of storage.

Format

The format is: Time-Series [1:29] from 1980 to 2008: 213000.00 295000.00 260000.00 175000.00 160000.00 ...

Details

The median annual cost of hard drives used in computers. The data are retail prices per GB taken from a sample of manufacturers.

Source

<http://ns1758.ca/winch/winchest.html>

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

djia	*Dow Jones Industrial Average*

Description

Daily DJIA values from April 2006 - April 2016

Format

The format is: xts [1:2518, 1:5] 11279 11343 11347 11337 11283 ...
- attr(*, "class")= chr [1:2] "xts" "zoo"
- attr(*, ".indexCLASS")= chr "Date"
- attr(*, ".indexTZ")= chr "UTC"
- attr(*, "tclass")= chr "Date"
- attr(*, "tzone")= chr "UTC"
- attr(*, "index")= atomic [1:2518] 1.15e+09 1.15e+09 1.15e+09 1.15e+09 1.15e+09 ...
..- attr(*, "tzone")= chr "UTC"
..- attr(*, "tclass")= chr "Date"
- attr(*, "dimnames")=List of 2
..$: NULL
..$: chr [1:5] "Open" "High" "Low" "Close" ...

Source

The data were obtained as follows, and can be updated in a similar way.
```
library(TTR) # install.packages('TTR') if you don't have it
djia  = getYahooData("^DJI", start=20060420, end=20160420, freq="daily")
```

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

econ5   *Five Quarterly Economic Series*

Description

Data frame containing quarterly U.S. unemployment, GNP, consumption, and government and private investment, from 1948-III to 1988-II.

Usage

```
data(econ5)
```

Format

A data frame with 161 observations (rows) on the following 5 numeric variables (columns): unemp, gnp, consum, govinv, prinv.

Source

Young, P.C. and Pedregal, D.J. (1999). Macro-economic relativity: government spending, private investment and unemployment in the USA 1948-1998. *Structural Change and Economic Dynamics*, 10, 359-380.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

EM0 *EM Algorithm for Time Invariant State Space Models*

Description

Estimation of the parameters in the model (6.1)–(6.2) via the EM algorithm.

Usage

```
EM0(num, y, A, mu0, Sigma0, Phi, cQ, cR, max.iter = 50, tol = 0.01)
```

Arguments

num	number of observations
y	observation vector or time series
A	time-invariant observation matrix
mu0	initial state mean vector
Sigma0	initial state covariance matrix
Phi	state transition matrix
cQ	Cholesky-like decomposition of state error covariance matrix Q – see details below
cR	Cholesky-like decomposition of state error covariance matrix R – see details below
max.iter	maximum number of iterations
tol	relative tolerance for determining convergence

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively.

Value

Phi	Estimate of Phi
Q	Estimate of Q
R	Estimate of R
mu0	Estimate of initial state mean
Sigma0	Estimate of initial state covariance matrix
like	-log likelihood at each iteration
niter	number of iterations to convergence
cvg	relative tolerance at convergence

Author(s)

D.S. Stoffer

References

http://www.stat.pitt.edu/stoffer/tsa4/

EM1   *EM Algorithm for General State Space Models*

Description

Estimation of the parameters in the general state space model via the EM algorithm. Inputs are not allowed; see the note.

Usage

```
EM1(num, y, A, mu0, Sigma0, Phi, cQ, cR, max.iter = 100, tol = 0.001)
```

Arguments

num	number of observations
y	observation vector or time series; use 0 for missing values
A	observation matrices, an array with dim=c(q,p,n); use 0 for missing values
mu0	initial state mean
Sigma0	initial state covariance matrix
Phi	state transition matrix
cQ	Cholesky-like decomposition of state error covariance matrix Q – see details below
cR	R is diagonal here, so cR = sqrt(R) – also, see details below
max.iter	maximum number of iterations
tol	relative tolerance for determining convergence

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively.

EQ5 17

Value

Phi	Estimate of Phi
Q	Estimate of Q
R	Estimate of R
mu0	Estimate of initial state mean
Sigma0	Estimate of initial state covariance matrix
like	-log likelihood at each iteration
niter	number of iterations to convergence
cvg	relative tolerance at convergence

Note

Inputs are not allowed (and hence not estimated). The script uses Ksmooth1 and everything related to inputs are set equal to zero when it is called.

It would be relatively easy to include estimates of 'Ups' and 'Gam' because conditional on the states, these are just regression coefficients. If you decide to alter EM1 to include estimates of the 'Ups' or 'Gam', feel free to notify me with a workable example and I'll include it in the next update.

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

EQ5 *Seismic Trace of Earthquake number 5*

Description

Seismic trace of an earthquake [two phases or arrivals along the surface, the primary wave ($t = 1, \ldots, 1024$) and the shear wave ($t = 1025, \ldots, 2048$)] recorded at a seismic station.

Format

The format is: Time-Series [1:2048] from 1 to 2048: 0.01749 0.01139 0.01512 0.01477 0.00651 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

eqexp

EQcount   *EQ Counts*

Description

Series of annual counts of major earthquakes (magnitude 7 and above) in the world between 1900 and 2006.

Format

The format is: Time-Series [1:107] from 1900 to 2006: 13 14 8 10 16 26 ...

Source

Zucchini and MacDonald (2009). Hidden Markov Models for Time Series: An Introduction using R. CRC Press.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

eqexp   *Earthquake and Explosion Seismic Series*

Description

This is a data frame of the earthquake and explosion seismic series used throughout the text.

Format

A data frame with 2048 observations (rows) on 17 variables (columns). Each column is a numeric vector.

Details

The matrix has 17 columns, the first eight are earthquakes, the second eight are explosions, and the last column is the Novaya Zemlya event of unknown origin.

The column names are: EQ1, EQ2,...,EQ8; EX1, EX2,...,EX8; NZ. The first 1024 observations correspond to the P wave, the second 1024 observations correspond to the S wave.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

EXP6 *Seismic Trace of Explosion number 6*

Description

Seismic trace of an explosion [two phases or arrivals along the surface, the primary wave ($t = 1, \ldots, 1024$) and the shear wave ($t = 1025, \ldots, 2048$)] recorded at a seismic station.

Format

The format is: Time-Series [1:2048] from 1 to 2048: -0.001837 -0.000554 -0.002284 -0.000303 -0.000721 ...

References

<http://www.stat.pitt.edu/stoffer/tsa3/>

See Also

eqexp

FDR *Basic False Discovery Rate*

Description

Computes the basic false discovery rate given a vector of p-values.

Usage

```
FDR(pvals, qlevel = 0.05)
```

Arguments

pvals	a vector of pvals on which to conduct the multiple testing
qlevel	the proportion of false positives desired

Value

fdr.id	NULL if no significant tests, or the index of the maximal p-value satisfying the FDR condition.

References

<http://www.stat.berkeley.edu/~paciorek/code/fdr/fdr.R>

---

flu   *Monthly pneumonia and influenza deaths in the U.S., 1968 to 1978.*

Description

Monthly pneumonia and influenza deaths per 10,000 people in the United States for 11 years, 1968
to 1978.

Usage

```
data(flu)
```

Format

The format is: Time-Series [1:132] from 1968 to 1979: 0.811 0.446 0.342 0.277 0.248 ...

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

fmri   *fMRI - complete data set*

Description

Data (as a vector list) from an fMRI experiment in pain, listed by location and stimulus. The data
are BOLD signals when a stimulus was applied for 32 seconds and then stopped for 32 seconds.
The signal period is 64 seconds and the sampling rate was one observation every 2 seconds for 256
seconds ($n = 128$). The number of subjects under each condition varies.

Details

The LOCATIONS of the brain where the signal was measured were [1] Cortex 1: Primary So-
matosensory, Contralateral, [2] Cortex 2: Primary Somatosensory, Ipsilateral, [3] Cortex 3: Sec-
ondary Somatosensory, Contralateral, [4] Cortex 4: Secondary Somatosensory, Ipsilateral, [5] Cau-
date, [6] Thalamus 1: Contralateral, [7] Thalamus 2: Ipsilateral, [8] Cerebellum 1: Contralateral
and [9] Cerebellum 2: Ipsilateral.

The TREATMENTS or stimuli (and number of subjects in each condition) are [1] Awake-Brush (5
subjects), [2] Awake-Heat (4 subjects), [3] Awake-Shock (5 subjects), [4] Low-Brush (3 subjects),
[5] Low-Heat (5 subjects), and [6] Low-Shock (4 subjects). Issue the command summary(fmri) for
further details. In particular, awake (Awake) or mildly anesthetized (Low) subjects were subjected
levels of periodic brushing (Brush), application of heat (Heat), and mild shock (Shock) effects.

As an example, fmri$L1T6 (Location 1, Treatment 6) will show the data for the four subjects
receiving the Low-Shock treatment at the Cortex 1 location; note that fmri[[6]] will display the
same data.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

fmri1	*fMRI Data Used in Chapter 1*

Description

A data frame that consists of average fMRI BOLD signals at eight locations.

Usage

```
data(fmri1)
```

Format

The format is: mts [1:128, 1:9]

Details

Multiple time series consisting of fMRI BOLD signals at eight locations (in columns 2-9, column 1 is time period), when a stimulus was applied for 32 seconds and then stopped for 32 seconds. The signal period is 64 seconds and the sampling rate was one observation every 2 seconds for 256 seconds ($n = 128$). The columns are labeled: "time" "cort1" "cort2" "cort3" "cort4" "thal1" "thal2" "cere1" "cere2".

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

fmri

---

gas	*Gas Prices*

Description

New York Harbor conventional regular gasoline weekly spot price FOB (in cents per gallon) from 2000 to mid-2010.

Format

The format is: Time-Series [1:545] from 2000 to 2010: 70.6 71 68.5 65.1 67.9 ...

Details

Pairs with series `oil`

Source

http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_w.htm

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

[oil](oil)

---

globtemp   *Global mean land-ocean temperature deviations - updated*

Description

Global mean land-ocean temperature deviations (from 1951-1980 average), measured in degrees centigrade, for the years 1880-2015. This is an update of gtemp.

Format

The format is: Time-Series [1:136] from 1880 to 2015: -0.2 -0.11 -0.1 -0.2 -0.28 -0.31 -0.3 -0.33 -0.2 -0.11 ...

Details

The data were changed after 2011, so there are discrepancies between this data set and gtemp. The differences are explained here: http://www1.ncdc.noaa.gov/pub/data/ghcn/v3/GHCNM-v3.2.0-FAQ.pdf.

Source

http://data.giss.nasa.gov/gistemp/graphs/

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

globtempl, gtemp, gtemp2

---

globtempl   *Global mean land (only) temperature deviations - updated*

Description

Global mean [land only] temperature deviations (from 1951-1980 average), measured in degrees centigrade, for the years 1880-2015. This is an update of gtemp2. Note the data file is globtemp-el not globtemp-one; the el stands for land.

Usage

```
data("globtempl")
```

Format

The format is: Time-Series [1:136] from 1880 to 2015: -0.53 -0.51 -0.41 -0.43 -0.72 -0.56 -0.7 -0.74 -0.53 -0.25 ...

Details

The data were changed after 2011, so there are discrepancies between this data set and gtemp2. The differences are explained here: http://www1.ncdc.noaa.gov/pub/data/ghcn/v3/GHCNM-v3.2.0-FAQ.pdf.

Source

http://data.giss.nasa.gov/gistemp/graphs/

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

[globtemp](), [gtemp2](), [gtemp]()

---

gnp   *Quarterly U.S. GNP*

Description

Quarterly U.S. GNP from 1947(1) to 2002(3).

Format

The format is: Time-Series [1:223] from 1947 to 2002: 1489 1497 1500 1524 1547 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

gtemp *Global mean land-ocean temperature deviations*

Description

This has been updated in [globtemp](#). Global mean land-ocean temperature deviations (from 1951-1980 average), measured in degrees centigrade, for the years 1880-2009.

Format

The format is: Time-Series [1:130] from 1880 to 2009: -0.28 -0.21 -0.26 -0.27 -0.32 -0.32 -0.29 -0.36 -0.27 -0.17 ...

Source

<http://data.giss.nasa.gov/gistemp/graphs/>

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[globtemp](#), [globtempl](#), [gtemp2](#)

---

gtemp2 *Global Mean Surface Air Temperature Deviations*

Description

This has been updated in [globtempl](#). Similar to gtemp but the data are based only on surface air temperature data obtained from meteorological stations. The data are temperature deviations (from 1951-1980 average), measured in degrees centigrade, for the years 1880-2009.

Usage

```
data(gtemp2)
```

Format

The format is: Time-Series [1:130] from 1880 to 2009: -0.24 -0.19 -0.14 -0.19 -0.45 -0.32 -0.42 -0.54 -0.24 -0.05 ...

Source

http://data.giss.nasa.gov/gistemp/graphs/

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

globtemp, globtempl, gtemp

HCT *Hematocrit Levels*

Description

HCT: Measurements made for 91 days on the three variables, log(white blood count) [WBC], log(platelet) [PLT] and hematocrit [HCT]. Missing data code is 0 (zero).

Format

The format is: Time-Series [1:91] from 1 to 91: 30 30 28.5 34.5 34 32 30.5 31 33 34 ...

Details

See Examples 6.1 and 6.9 for more details.

Source

Jones, R.H. (1984). Fitting multivariate models to unequally spaced data. In *Time Series Analysis of Irregularly Observed Data*, pp. 158-188. E. Parzen, ed. Lecture Notes in Statistics, 25, New York: Springer-Verlag.

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

blood, PLT, WBC

---

hor   *Hawaiian occupancy rates*

Description

Quarterly Hawaiian hotel occupancy rate (percent of rooms occupied) from 1982-I to 2015-IV

Format

The format is: Time-Series [1:136] from 1982 to 2015: 79 65.9 70.9 66.7 ...

Source

<http://dbedt.hawaii.gov/economic/qser/tourism/>

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
plot(hor, type='c')                           # plot data and
text(hor, labels=1:4, col=c(1,4,2,6), cex=.9)  # add quarter labels
#
plot(stl(hor, s.window=15))  # fit structural model
```

---

jj   *Johnson and Johnson Quarterly Earnings Per Share*

Description

Johnson and Johnson quarterly earnings per share, 84 quarters (21 years) measured from the first quarter of 1960 to the last quarter of 1980.

Format

The format is: Time-Series [1:84] from 1960 to 1981: 0.71 0.63 0.85 0.44 0.61 0.69 0.92 0.55 0.72 0.77 ...

Details

This data set is also included with the R distribution as JohnsonJohnson

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Kfilter0 *Kalman Filter - Time Invariant Model*

Description

Returns the filtered values for the basic time invariant state-space model; inputs are not allowed.

Usage

```
Kfilter0(num, y, A, mu0, Sigma0, Phi, cQ, cR)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-invariant observation matrix
mu0	initial state mean vector
Sigma0	initial state covariance matrix
Phi	state transition matrix
cQ	Cholesky-type decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below

Details

Practically, the script only requires that Q or R may be reconstructed as `t(cQ)%*%(cQ)` or `t(cR)%*%(cR)`, respectively.

Value

xp	one-step-ahead state prediction
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
innov	innovation series
sig	innovation covariances
Kn	last value of the gain, needed for smoothing

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

Kfilter1	*Kalman Filter - Model may be time varying or have inputs*

Description

Returns both the predicted and filtered values for a linear state space model. Also evaluates the likelihood at the given parameter values.

Usage

```
Kfilter1(num, y, A, mu0, Sigma0, Phi, Ups, Gam, cQ, cR, input)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-varying observation matrix, an array with dim=c(q,p,n)
mu0	initial state mean
Sigma0	initial state covariance matrix
Phi	state transition matrix
Ups	state input matrix; use Ups = 0 if not needed
Gam	observation input matrix; use Gam = 0 if not needed
cQ	Cholesky-type decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below
input	matrix or vector of inputs having the same row dimension as y; use input = 0 if not needed

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively.

Value

xp	one-step-ahead prediction of the state
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
innov	innovation series
sig	innovation covariances
Kn	last value of the gain, needed for smoothing

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

Kfilter2	*Kalman Filter - Model may be time varying or have inputs or correlated errors*

Description

Returns the filtered values for the state space model. In addition, the script returns the evaluation of the likelihood at the given parameter values and the innovation sequence.

Usage

```
Kfilter2(num, y, A, mu0, Sigma0, Phi, Ups, Gam, Theta, cQ, cR,
         S, input)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-varying observation matrix, an array with dim = c(q,p,n)
mu0	initial state mean
Sigma0	initial state covariance matrix
Phi	state transition matrix

Ups	state input matrix; use `Ups = 0` if not needed
Gam	observation input matrix; use `Gam = 0` if not needed
Theta	state error pre-matrix
cQ	Cholesky decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below
S	covariance-type matrix of state and observation errors
input	matrix or vector of inputs having the same row dimension as y; use `input = 0` if not needed

Details

Practically, the script only requires that Q or R may be reconstructed as `t(cQ)%*%(cQ)` or `t(cR)%*%(cR)`, respectively.

Value

xp	one-step-ahead prediction of the state
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
innov	innovation series
sig	innovation covariances
K	last value of the gain, needed for smoothing

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

Ksmooth0   *Kalman Filter and Smoother - Time invariant model without inputs*

Description

Returns both the filtered values and smoothed values for the state-space model.

Usage

```
Ksmooth0(num, y, A, mu0, Sigma0, Phi, cQ, cR)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-invariant observation matrix
mu0	initial state mean vector
Sigma0	initial state covariance matrix
Phi	state transition matrix
cQ	Cholesky-type decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively, which allows more flexibility.

Value

xs	state smoothers
Ps	smoother mean square error
x0n	initial mean smoother
P0n	initial smoother covariance
J0	initial value of the J matrix
J	the J matrices
xp	one-step-ahead prediction of the state
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
Kn	last value of the gain

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

Ksmooth1	*Kalman Filter and Smoother - General model*

Description

Returns both the filtered and the smoothed values for the state-space model.

Usage

```
Ksmooth1(num, y, A, mu0, Sigma0, Phi, Ups, Gam, cQ, cR, input)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-varying observation matrix, an array with dim=c(q,p,n)
mu0	initial state mean
Sigma0	initial state covariance matrix
Phi	state transition matrix
Ups	state input matrix; use Ups = 0 if not needed
Gam	observation input matrix; use Gam = 0 if not needed
cQ	Cholesky-type decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below
input	matrix or vector of inputs having the same row dimension as y; use input = 0 if not needed

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively, which allows more flexibility.

Value

xs	state smoothers
Ps	smoother mean square error
x0n	initial mean smoother
P0n	initial smoother covariance
J0	initial value of the J matrix
J	the J matrices
xp	one-step-ahead prediction of the state
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
Kn	last value of the gain

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

Ksmooth2	*Kalman Filter and Smoother - General model, may have correlated errors*

Description

Returns the filtered and smoothed values for the state-space model. This is the smoother companion to Kfilter2.

Usage

```
Ksmooth2(num, y, A, mu0, Sigma0, Phi, Ups, Gam, Theta, cQ, cR,
         S, input)
```

Arguments

num	number of observations
y	data matrix, vector or time series
A	time-varying observation matrix, an array with dim=c(q,p,n)
mu0	initial state mean
Sigma0	initial state covariance matrix
Phi	state transition matrix
Ups	state input matrix; use Ups = 0 if not needed
Gam	observation input matrix; use Gam = 0 if not needed
Theta	state error pre-matrix
cQ	Cholesky-type decomposition of state error covariance matrix Q – see details below
cR	Cholesky-type decomposition of observation error covariance matrix R – see details below
S	covariance matrix of state and observation errors
input	matrix or vector of inputs having the same row dimension as y; use input = 0 if not needed

Details

Practically, the script only requires that Q or R may be reconstructed as t(cQ)%*%(cQ) or t(cR)%*%(cR), respectively, which allows more flexibility.

Value

xs	state smoothers
Ps	smoother mean square error
J	the J matrices
xp	one-step-ahead prediction of the state
Pp	mean square prediction error
xf	filter value of the state
Pf	mean square filter error
like	the negative of the log likelihood
Kn	last value of the gain

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See also <http://www.stat.pitt.edu/stoffer/tsa4/chap6.htm> for an explanation of the difference between levels 0, 1, and 2.

`lag1.plot` *Lag Plot - one time series*

Description

Produces a grid of scatterplots of a series versus lagged values of the series.

Usage

```
lag1.plot(series, max.lag = 1, corr = TRUE, smooth = TRUE)
```

Arguments

`series`	the data
`max.lag`	maximum lag
`corr`	if TRUE, shows the autocorrelation value in a legend
`smooth`	if TRUE, adds a lowess fit to each scatterplot

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
lag1.plot(soi, 9)
```

`lag2.plot` *Lag Plot - two time series*

Description

Produces a grid of scatterplots of one series versus another. The first named series is the one that gets lagged.

Usage

```
lag2.plot(series1, series2, max.lag = 0, corr = TRUE, smooth = TRUE)
```

Arguments

series1	first series (the one that gets lagged)
series2	second series
max.lag	maximum number of lags
corr	if TRUE, shows the cross-correlation value in a legend
smooth	if TRUE, adds a lowess fit to each scatterplot

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

Examples

```
lag2.plot(soi, rec, 8)
```

LagReg	*Lagged Regression*

Description

Performs lagged regression as discussed in Chapter 4.

Usage

```
LagReg(input, output, L = c(3, 3), M = 40, threshold = 0,
        inverse = FALSE)
```

Arguments

input	input series
output	output series
L	degree of smoothing; see spans in the help file for spec.pgram.
M	must be even; number of terms used in the lagged regression
threshold	the cut-off used to set small (in absolute value) regression coeffcients equal to zero
inverse	if TRUE, will fit a forward-lagged regression

Details

For a bivariate series, input is the input series and output is the output series. The degree of smoothing for the spectral estimate is given by L; see spans in the help file for spec.pgram. The number of terms used in the lagged regression approximation is given by M, which must be even. The threshold value is the cut-off used to set small (in absolute value) regression coeffcients equal to zero (it is easiest to run LagReg twice, once with the default threshold of zero, and then again after inspecting the resulting coeffcients and the corresponding values of the CCF). Setting inverse=TRUE will fit a forward-lagged regression; the default is to run a backward-lagged regression. The script is based on code that was contributed by Professor Doug Wiens, Department of Mathematical and Statistical Sciences, University of Alberta.

Value

Graphs of the estimated impulse response function, the CCF, and the output with the predicted values superimposed.

beta	Estimated coefficients
fit	The output series, the fitted values, and the residuals

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

lap	*LA Pollution-Mortality Study*

Description

LA Pollution-Mortality Study (1970-1979, weekly data).

Format

The format is: mts [1:508, 1:11]

Details

columns are time series	with names
(1) Total Mortality	tmort
(2) Respiratory Mortality	rmort
(3) Cardiovascular Mortality	cmort
(4) Temperature	tempr
(5) Relative Humidity	rh
(6) Carbon Monoxide	co

(7) Sulfur Dioxide	so2
(8) Nitrogen Dioxide	no2
(9) Hydrocarbons	hycarb
(10) Ozone	o3
(11) Particulates	part

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

lead   *Leading Indicator*

Description

Leading indicator, 150 months; taken from Box and Jenkins (1970).

Usage

```
data(lead)
```

Format

The format is: Time-Series [1:150] from 1 to 150: 10.01 10.07 10.32 9.75 10.33 ...

Details

This is also the R time series BJsales.lead: The sales time series BJsales and leading indicator BJsales.lead each contain 150 observations. The objects are of class "ts".

See Also

[sales](#)

---

mvspec   *Univariate and Multivariate Spectral Estimation*

Description

This is spec.pgram with a few changes in the defaults and written so you can easily extract the estimate of the multivariate spectral matrix as fxx. The bandwidth calculation has been changed to the more practical definition given in the text. Can be used to replace spec.pgram for univariate series.

Usage

```
mvspec(x, spans = NULL, kernel = NULL, taper = 0, pad = 0,
          fast = TRUE, demean = FALSE, detrend = TRUE,
          plot = TRUE, na.action = na.fail, ...)
```

Arguments

x	univariate or multivariate time series (i.e., the p columns of x are time series)
spans	specify smoothing; same as spec.pgram
kernel	specify kernel; same as spec.pgram
taper	specify taper; same as spec.pgram with different default
pad	specify padding; same as spec.pgram
fast	specify use of FFT; same as spec.pgram
demean	if TRUE, series is demeaned first; same as spec.pgram
detrend	if TRUE, series is detrended first; same as spec.pgram
plot	plot the estimate; same as spec.pgram
na.action	same as spec.pgram
...	additional arguments; same as spec.pgram

Details

This is spec.pgram with a few changes in the defaults and written so you can easily extract the estimate of the multivariate spectral matrix as fxx. The bandwidth calculation has been changed to the more practical definition given in the text, $(L_h/n.used) * frequency(x)$. Although meant to be used to easily obtain multivariate spectral estimates, this script can be used for univariate time series. Note that the script does not taper by default (taper=0); this forces the user to do "conscious tapering".

Value

An object of class "spec", which is a list containing at least the following components:

fxx   spectral matrix estimates; an array of dimensions dim = c(p,p,nfreq)

freq   vector of frequencies at which the spectral density is estimated.

spec   vector (for univariate series) or matrix (for multivariate series) of estimates of the spectral density at frequencies corresponding to freq.

coh   NULL for univariate series. For multivariate time series, a matrix containing the squared coherency between different series. Column i + (j - 1) * (j - 2)/2 of coh contains the squared coherency between columns i and j of x, where i < j.

phase   NULL for univariate series. For multivariate time series a matrix containing the cross-spectrum phase between different series. The format is the same as coh.

Lh   Number of frequencies (approximate) used in the band, as defined in Chapter 4.

n.used   Sample length used for the FFT

series   The name of the time series.

snames   For multivariate input, the names of the component series.

method   The method used to calculate the spectrum.

The results are returned invisibly if plot is true.

References

http://www.stat.pitt.edu/stoffer/tsa4/

Examples

```
# univariate example
plot(co2)    # co2 is an R data set
mvspec(co2, spans=c(5,5), taper=.5)

# multivariate example
ts.plot(mdeaths, fdeaths, col=1:2)   # an R data set, male/female monthly deaths ...
dog = mvspec(cbind(mdeaths,fdeaths), spans=c(3,3), taper=.1)
dog$fxx       # look a spectral matrix estimates
dog$bandwidth  # bandwidth with time unit = year
dog$bandwidth/frequency(mdeaths)  # ... with time unit = month
plot(dog, plot.type="coherency")  # plot of squared coherency
```

---

nyse   *Returns of the New York Stock Exchange*

Description

Returns of the New York Stock Exchange (NYSE) from February 2, 1984 to December 31, 1991.

Usage

```
data(nyse)
```

Format

The format is: Time-Series [1:2000] from 1 to 2000: 0.00335 -0.01418 -0.01673 0.00229 -0.01692 ...

Source

S+GARCH module - Version 1.1 Release 2: 1998

---

oil   *Crude oil, WTI spot price FOB*

Description

Crude oil, WTI spot price FOB (in dollars per barrel), weekly data from 2000 to mid-2010.

Format

The format is: Time-Series [1:545] from 2000 to 2010: 26.2 26.1 26.3 24.9 26.3 ...

Details

pairs with the series gas

Source

http://tonto.eia.doe.gov/dnav/pet/pet_pri_spt_s1_w.htm

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

[gas](gas)

---

part   *Particulate levels from the LA pollution study*

Description

Particulate series corresponding to cmort from the LA pollution study.

Format

The format is: Time-Series [1:508] from 1970 to 1980: 72.7 49.6 55.7 55.2 66 ...

See Also

[lap](#)

PLT   *Platelet Levels*

Description

PLT: Measurements made for 91 days on the three variables, log(white blood count) [WBC], log(platelet) [PLT] and hematocrit [HCT]. Missing data code is 0 (zero).

Usage

```
data(PLT)
```

Format

The format is: Time-Series [1:91] from 1 to 91: 4.47 4.33 4.09 4.6 4.41 ...

Details

See Examples 6.1 and 6.9 for more details.

Source

Jones, R.H. (1984). Fitting multivariate models to unequally spaced data. In *Time Series Analysis of Irregularly Observed Data*, pp. 158-188. E. Parzen, ed. Lecture Notes in Statistics, 25, New York: Springer-Verlag.

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

[blood](#), [HCT](#), [WBC](#)

---

prodn *Monthly Federal Reserve Board Production Index*

Description

Monthly Federal Reserve Board Production Index (1948-1978, n = 372 months).

Usage

```
data(prodn)
```

Format

The format is: Time-Series [1:372] from 1948 to 1979: 40.6 41.1 40.5 40.1 40.4 41.2 39.3 41.6 42.3 43.2 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

qinfl *Quarterly Inflation*

Description

Quarterly inflation rate in the Consumer Price Index from 1953-Ito 1980-II, n = 110 observations.

Format

The format is: Time-Series [1:110] from 1953 to 1980: 1.673 3.173 0.492 -0.327 -0.333 ...

Details

pairs with qintr (interest rate)

Source

Newbold, P. and T. Bos (1985). *Stochastic Parameter Regression Models*. Beverly Hills: Sage.

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

qintr

---

qintr   *Quarterly Interest Rate*

Description

Quarterly interest rate recorded for Treasury bills from 1953-Ito 1980-II, n = 110 observations.

Format

The format is: Time-Series [1:110] from 1953 to 1980: 1.98 2.15 1.96 1.47 1.06 ...

Details

pairs with qinfl (inflation)

Source

Newbold, P. and T. Bos (1985). *Stochastic Parameter Regression Models*. Beverly Hills: Sage.

References

See <http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[qinfl](#)

---

rec   *Recruitment (number of new fish)*

Description

Recruitment (number of new fish) for a period of 453 months ranging over the years 1950-1987.

Usage

```
data(rec)
```

Format

The format is: Time-Series [1:453] from 1950 to 1988: 68.6 68.6 68.6 68.6 68.6 ...

Details

can pair with soi (Southern Oscillation Index)

Source

Data furnished by Dr. Roy Mendelssohn of the Pacific Fisheries Environmental Laboratory, NOAA (personal communication).

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

soi

---

sales	*Sales*

Description

Sales, 150 months; taken from Box and Jenkins (1970).

Format

The format is: Time-Series [1:150] from 1 to 150: 200 200 199 199 199 ...

Details

This is also the R data set `BJsales`: The sales time series `BJsales` and leading indicator `BJsales.lead` each contain 150 observations. The objects are of class "ts".

See Also

lead

---

salt	*Salt Profiles*

Description

Salt profiles taken over a spatial grid set out on an agricultural field, 64 rows at 17-ft spacing.

Usage

```
data(salt)
```

Format

The format is: Time-Series [1:64] from 1 to 64: 6 6 6 3 3 3 4 4 4 1.5 ...

Details

pairs with `saltemp`, temperature profiles on the same grid

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[saltemp](#)

---

saltemp   *Temperature Profiles*

Description

Temperature profiles over a spatial grid set out on an agricultural field, 64 rows at 17-ft spacing.

Usage

```
data(saltemp)
```

Format

The format is: Time-Series [1:64] from 1 to 64: 5.98 6.54 6.78 6.34 6.96 6.51 6.72 7.44 7.74 6.85
...

Details

pairs with `salt`, salt profiles on the same grid

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[salt](#)

---

sarima	*Fit ARIMA Models*

Description

Fits ARIMA models (including improved diagnostics) in a short command. It can also be used to perform regression with autocorrelated errors. This is a front end to arima() with a different back door.

Usage

```
sarima(xdata, p, d, q, P = 0, D = 0, Q = 0, S = -1,
       details = TRUE, xreg=NULL, Model=TRUE,
       tol = sqrt(.Machine$double.eps),
       no.constant = FALSE)
```

Arguments

xdata	univariate time series
p	AR order (must be specified)
d	difference order (must be specified)
q	MA order (must be specified)
P	SAR order; use only for seasonal models
D	seasonal difference; use only for seasonal models
Q	SMA order; use only for seasonal models
S	seasonal period; use only for seasonal models
xreg	Optionally, a vector or matrix of external regressors, which must have the same number of rows as xdata.
Model	if TRUE (default), the model orders are printed on the diagnostic plot.
details	if FALSE, turns off the diagnostic plot and the output from the nonlinear optimization routine, which is optim. The default is TRUE.
tol	controls the relative tolerance (reltol in optim) used to assess convergence. The default is sqrt(.Machine$double.eps), the R default.
no.constant	controls whether or not sarima includes a constant in the model. In particular, if there is no differencing ($d = 0$ and $D = 0$) you get the mean estimate. If there is differencing of order one (either $d = 1$ or $D = 1$, but not both), a constant term is included in the model. These two conditions may be overridden (i.e., no constant will be included in the model) by setting this to TRUE; e.g., sarima(x,1,1,0,no.constant=TRUE). Otherwise, no constant or mean term is included in the model. If regressors are included (via xreg), this is ignored.

Details

If your time series is in x and you want to fit an ARIMA(p,d,q) model to the data, the basic call is sarima(x,p,d,q). The values p,d,q, must be specified as there is no default. The results are the parameter estimates, standard errors, AIC, AICc, BIC (as defined in Chapter 2) and diagnostics. To fit a seasonal ARIMA model, the basic call is sarima(x,p,d,q,P,D,Q,S). For example, sarima(x,2,1,0) will fit an ARIMA(2,1,0) model to the series in x, and sarima(x,2,1,0,0,1,1,12) will fit a seasonal ARIMA$(2, 1, 0) * (0, 1, 1)_{12}$ model to the series in x. The difference between the information criteria given by sarima() and arima() is that they essentially differ by a factor of the sample size. Precise details are explained in Chapter 2, footnote 2.

Value

`fit`	the `arima` object
`degrees_of_freedom`	
	Error degrees of freedom
`ttable`	a little t-table with two-sided p-values
`AIC`	value of the AIC
`AICc`	value of the AICc
`BIC`	value of the BIC

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[sarima.for](#)

Examples

```
sarima(log(AirPassengers),0,1,1,0,1,1,12)
(dog <- sarima(log(AirPassengers),0,1,1,0,1,1,12))
summary(dog$fit)  # fit has all the returned arima() values
plot(resid(dog$fit))  # plot the innovations (residuals)
sarima(log(AirPassengers),0,1,1,0,1,1,12,details=FALSE)$BIC  # print model BIC only
```

---

sarima.for   *ARIMA Forecasting*

Description

ARIMA forecasting - this is a wrapper for R's predict.Arima.

Usage

```
sarima.for(xdata, n.ahead, p, d, q, P = 0, D = 0, Q = 0, S = -1,
           tol = sqrt(.Machine$double.eps), no.constant = FALSE,
           plot.all=FALSE, xreg = NULL, newxreg = NULL)
```

Arguments

xdata	univariate time series
n.ahead	forecast horizon (number of periods)
p	AR order
d	difference order
q	MA order
P	SAR order; use only for seasonal models
D	seasonal difference; use only for seasonal models
Q	SMA order; use only for seasonal models
S	seasonal period; use only for seasonal models
tol	controls the relative tolerance (reltol) used to assess convergence. The default is sqrt(.Machine$double.eps), the R default.
no.constant	controls whether or not a constant is included in the model. If no.constant=TRUE, no constant is included in the model. See [sarima](#) for more details.
plot.all	if TRUE, all the data are plotted in the graphic; otherwise, only the last 100 observations are plotted in the graphic.
xreg	Optionally, a vector or matrix of external regressors, which must have the same number of rows as the series. If this is used, newxreg MUST be specified.
newxreg	New values of xreg to be used for prediction. Must have at least n.ahead rows.

Details

For example, sarima.for(x,5,1,0,1) will forecast five time points ahead for an ARMA(1,1) fit to x. The output prints the forecasts and the standard errors of the forecasts, and supplies a graphic of the forecast with +/- 1 and 2 prediction error bounds.

Value

pred	the forecasts
se	the prediction (standard) errors

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

See Also

[sarima](#)

Examples

```
sarima.for(log(AirPassengers),12,0,1,1,0,1,1,12)
#  with regressors:
nummy  = length(soi)
n.ahead = 24
nureg  = time(soi)[nummy] + seq(1,n.ahead)/12
sarima.for(soi,n.ahead,2,0,0,2,0,0,12, xreg=time(soi), newxreg=nureg)
```

SigExtract   *Signal Extraction And Optimal Filtering*

Description

Performs signal extraction and optimal filtering as discussed in Chapter 4.

Usage

```
SigExtract(series, L = c(3, 3), M = 50, max.freq = 0.05)
```

Arguments

series	univariate time series to be filtered
L	degree of smoothing (may be a vector); see spans in spec.pgram for more details
M	number of terms used in the lagged regression approximation
max.freq	truncation frequency, which must be larger than 1/M.

Details

The basic function of the script, and the default setting, is to remove frequencies above 1/20 (and, in particular, the seasonal frequency of 1 cycle every 12 time points). The sampling frequency of the time series is set to unity prior to the analysis.

Value

Returns plots of (1) the original and filtered series, (2) the estiamted spectra of each series, (3) the filter coefficients and the desired and attained frequency response function. The filtered series is returned invisibly.

Note

The script is based on code that was contributed by Professor Doug Wiens, Department of Mathematical and Statistical Sciences, University of Alberta.

Author(s)

D.S. Stoffer

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

so2	*SO2 levels from the LA pollution study*

Description

Sulfur dioxide levels from the LA pollution study

Format

The format is: Time-Series [1:508] from 1970 to 1980: 3.37 2.59 3.29 3.04 3.39 2.57 2.35 3.38 1.5 2.56 ...

See Also

lap

---

soi	*Southern Oscillation Index*

Description

Southern Oscillation Index (SOI) for a period of 453 months ranging over the years 1950-1987.

Format

The format is: Time-Series [1:453] from 1950 to 1988: 0.377 0.246 0.311 0.104 -0.016 0.235 0.137 0.191 -0.016 0.29 ...

Details

pairs with rec (Recruitment)

Source

Data furnished by Dr. Roy Mendelssohn of the Pacific Fisheries Environmental Laboratory, NOAA (personal communication).

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

rec

---

soiltemp   *Spatial Grid of Surface Soil Temperatures*

Description

A 64 by 36 matrix of surface soil temperatures.

Format

The format is: num [1:64, 1:36] 6.7 8.9 5 6.6 6.1 7 6.5 8.2 6.7 6.6 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

sp500w   *Weekly Growth Rate of the Standard and Poor's 500*

Description

Weekly closing returns of the SP 500 from 2003 to September, 2012.

Format

An 'xts' object on 2003-01-03 to 2012-09-28; Indexed by objects of class: [Date] TZ: UTC

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

speech   *Speech Recording*

Description

A small .1 second (1000 points) sample of recorded speech for the phrase "aaa...hhh".

Format

The format is: Time-Series [1:1020] from 1 to 1020: 1814 1556 1442 1416 1352 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

star	*Variable Star*

Description

The magnitude of a star taken at midnight for 600 consecutive days. The data are taken from the classic text, The Calculus of Observations, a Treatise on Numerical Mathematics, by E.T. Whittaker and G. Robinson, (1923, Blackie and Son, Ltd.).

Format

The format is: Time-Series [1:600] from 1 to 600: 25 28 31 32 33 33 32 ...

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

stoch.reg	*Frequency Domain Stochastic Regression*

Description

Performs frequency domain stochastic regression discussed in Chapter 7.

Usage

```
stoch.reg(data, cols.full, cols.red, alpha, L, M, plot.which)
```

Arguments

data	data matrix
cols.full	specify columns of data matrix that are in the full model
cols.red	specify columns of data matrix that are in the reduced model (use NULL if there are no inputs in the reduced model)
alpha	test size
L	smoothing - see spans in spec.pgram
M	number of points in the discretization of the integral
plot.which	coh or F.stat, to plot either the squared-coherencies or the F-statistics, respectively

Value

`power.full`	spectrum under the full model
`power.red`	spectrum under the reduced model
`Betahat`	regression parameter estimates
`eF`	pointwise (by frequency) F-tests
`coh`	coherency

Note

The script is based on code that was contributed by Professor Doug Wiens, Department of Mathematical and Statistical Sciences, University of Alberta. See Example 7.1 on page 417 for a demonstration.

Author(s)

D.S. Stoffer

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

sunspotz	*Biannual Sunspot Numbers*

Description

Biannual smoothed (12-month moving average) number of sunspots from June 1749 to December 1978; n = 459. The "z" on the end is to distinguish this series from the one included with R (called `sunspots`).

Format

The format is: Time Series: Start = c(1749, 1) End = c(1978, 1) Frequency = 2

References

http://www.stat.pitt.edu/stoffer/tsa4/

SVfilter   *Switching Filter (for Stochastic Volatility Models)*

Description

Performs a special case switching filter when the observational noise is a certain mixture of normals. Used to fit a stochastic volatility model.

Usage

```
SVfilter(num, y, phi0, phi1, sQ, alpha, sR0, mu1, sR1)
```

Arguments

num	number of observations
y	time series of returns
phi0	state constant
phi1	state transition parameter
sQ	state standard deviation
alpha	observation constant
sR0	observation error standard deviation for mixture component zero
mu1	observation error mean for mixture component one
sR1	observation error standard deviation for mixture component one

Value

xp	one-step-ahead prediction of the volatility
Pp	mean square prediction error of the volatility
like	the negative of the log likelihood at the given parameter values

Author(s)

D.S. Stoffer

References

<http://www.stat.pitt.edu/stoffer/tsa4/>

---

tempr   *Temperatures from the LA pollution study*

Description

Temperature series corresponding to cmort from the LA pollution study.

Format

The format is: Time-Series [1:508] from 1970 to 1980: 72.4 67.2 62.9 72.5 74.2 ...

See Also

[lap](#)

---

tsplot   *Time Series Plot*

Description

Produces a nice plot of a univariate time series in one easy line.

Usage

```
tsplot(x, y=NULL, main=NULL, ylab=NULL, xlab='Time', type='l', margins=.25, ... )
```

Arguments

x, y	time series to be plotted; if both present, x will be the time index.
main	add a plot title - the default is no title.
ylab	y-axis label - the default is the name of the ts object.
xlab	x-axis label - the default is 'Time'.
type	type of plot - the default is line.
margins	inches to add (or subtract) to the margins.
...	other graphical parameteres; see [par](#).

Note

This script is meant to be used for demonstrations so that a nice time series plot can be produced in one quick and easy statement. You can use it to do tricks, but you might get warnings because I had to use 2 levels of graphics to avoid having the grid on top of the line. For example, axes = FALSE will work, but you will get a warning because it applies to one level and not the other.

Author(s)

D.S. Stoffer

References

http://www.stat.pitt.edu/stoffer/tsa4/

Examples

```
tsplot(soi, col=4)
#
tsplot(soi, main="Southern Oscillation Index")
#
par(mfrow=2:1)
tsplot(soi, main="Title for Both")
tsplot(rec)
#
tsplot(1:453, soi, ylab='SOI', xlab='Month')
```

---

unemp	*U.S. Unemployment*

Description

Monthly U.S. Unemployment series (1948-1978, n = 372)

Usage

```
data(unemp)
```

Format

The format is: Time-Series [1:372] from 1948 to 1979: 235 281 265 241 201 ...

References

http://www.stat.pitt.edu/stoffer/tsa4/

UnempRate   *U.S. Unemployment Rate*

Description

Monthly U.S. unemployment rate in percent unemployed (Jan, 1948 - Nov, 2016, n = 827)

Format

The format is: Time-Series [1:827] from 1948 to 2017: 4 4.7 4.5 4 3.4 3.9 3.9 3.6 3.4 2.9 ...

Source

https://data.bls.gov/timeseries/LNU04000000/

References

http://www.stat.pitt.edu/stoffer/tsa4/

---

varve   *Annual Varve Series*

Description

Sedimentary deposits from one location in Massachusetts for 634 years, beginning nearly 12,000 years ago.

Format

The format is: Time-Series [1:634] from 1 to 634: 26.3 27.4 42.3 58.3 20.6 ...

References

http://www.stat.pitt.edu/stoffer/tsa4/

WBC   *White Blood Cell Levels*

Description

WBC: Measurements made for 91 days on the three variables, log(white blood count) [WBC], log(platelet) [PLT] and hematocrit [HCT]. Missing data code is 0 (zero).

Format

The format is: Time-Series [1:91] from 1 to 91: 2.33 1.89 2.08 1.82 1.82 ...

Details

See Examples 6.1 amd 6.9 for more details.

Source

Jones, R.H. (1984). Fitting multivariate models to unequally spaced data. In *Time Series Analysis of Irregularly Observed Data*, pp. 158-188. E. Parzen, ed. Lecture Notes in Statistics, 25, New York: Springer-Verlag.

References

http://www.stat.pitt.edu/stoffer/tsa4/

See Also

blood, HCT, PLT

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