Package ‘tsapp’

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Type Package

Title Time Series, Analysis and Application

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Author Rainer Schlittgen

Maintainer Rainer Schlittgen <R.Schlittgen@t-online.de>

Description Accompanies the book Rainer Schlittgen and Cristina Sattarhoff (2020) <https://www.degruyter.com/view/title/575978> ``Angewandte Zeitreihenanalyse mit R, 4. Auflage'' . The package contains the time series and functions used therein. It was developed over many years teaching courses about time series analysis.

License GPL

Encoding UTF-8

LazyData true

Depends R (>= 3.6.0), Matrix , vars, fftwtools

SystemRequirements under Linux, fftwtools needs libfftw3-dev

RoxygenNote 7.0.2

NeedsCompilation no

Repository CRAN

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R topics documented:

`ACCIDENT` *Monthly numbers of road traffic accidents with personal injury in BRD*

Description

Monthly numbers of road traffic accidents with personal injury in BRD

Usage

```
ACCIDENT
```

Format

ACCIDENT is a univariate time series of length 528, start January 1974, frequency = 12

ACCIDENT Monthly numbers of road traffic accidents with personal injury

Source

< https://www-genesis.destatis.de/genesis//online?operation=table&code=46241-0002&levelindex=0&levelid=15837491149

Examples

```
data(ACCIDENT)
## maybe  tsp(ACCIDENT) ; plot(ACCIDENT)
```

`acfmat` — `acfmat` *computes a sequence of autocorrelation matrices for a multivariate time series*

Description

`acfmat` computes a sequence of autocorrelation matrices for a multivariate time series

Usage

```
acfmat(y, lag.max)
```

Arguments

`y`	multivariate time series
`lag.max`	maximum number of lag

Value

out list with components:

`M`	array with autocovariance matrices
`M1`	array with indicators if autocovariances are significantly greater (+), lower (-) than the critical value or insignificant (.) at 95 percent level

Examples

```
data(ICECREAM)
out <- acfmat(ICECREAM,7)
```

acfpacf — acfpacf *produces a plot of the acf and the pacf of a time series*

Description

`acfpacf` produces a plot of the acf and the pacf of a time series

Usage

```
acfpacf(x, lag, HV = "H")
```

Arguments

`x`	the series, a vector or a time series
`lag`	scalar, maximal lag to be plotted
`HV`	character, controls division of graphic window: "H" horizontal, "V" vertical, default is "H"

Examples

```
data(LYNX)
acfpacf(log(LYNX),15,HV="H")
```

ALCINCOME — *Alcohol Demand, UK, 1870-1938.*

Description

Alcohol Demand, UK, 1870-1938.

Usage

```
ALCINCOME
```

Format

ALCINCOME is a threevariate time series of length 69 and 3 variables; start 1870, frequency = 1

Y log consumption per head

Z log real income per head

X log real price

Source

Durbin & Watson (1951) <https://doi.org/10.1093/biomet/38.1-2.159>

Examples

```
data(ALCINCOME)
## maybe  tsp(ALCINCOME) ; plot(ALCINCOME)
```

---

armathspec — `armathspec` *determines the theoretical spectrum of an arma process*

Description

`armathspec` determines the theoretical spectrum of an arma process

Usage

```
armathspec(a, b, nf, s = 1, pl = FALSE)
```

Arguments

`a`	ar-coefficients
`b`	ma-coefficients
`nf`	scalar, the number of equally spaced frequencies
`s`	variance of error process
`pl`	logical, if TRUE, the spectrum is plotted, FALSE for no plot

Value

out (nf+1,2) matrix, the frequencies and the spectrum

Examples

```
out <-armathspec(c(0.3,-0.5),c(-0.8,0.7),50,s=1,pl=FALSE)
```

---

aspectratio — `aspectratio` *determines the aspect ratio to plot a time series*

Description

`aspectratio` determines the aspect ratio to plot a time series

Usage

```
aspectratio(y)
```

Arguments

`y`	time series

Value

a scalar, the aspect ratio

Examples

```
data(GDP)
a <- aspectratio(GDP)
```

`bandfilt`   `bandfilt` *does a bandpass filtering of a time series*

Description

`bandfilt` does a bandpass filtering of a time series

Usage

```
bandfilt(y, q, pl, pu)
```

Arguments

`y`	the series, a vector or a time series
`q`	scalar, half of length of symmetric weights
`pl`	scalar, lower periodicity (>= 2)
`pu`	scalar, upper periodicity (> pl)

Value

yf (n,1) vector, the centered filtered time series with NA's at beginning and ending

Examples

```
data(GDP)
yf <- bandfilt(GDP,5,2,6)
plot(GDP); lines(yf+mean(GDP),col="red")
```

BEER *Monthly beer production in Australia: megalitres. Includes ale and stout. Does not include beverages with alcohol percentage less than 1.15.*

Description

Monthly beer production in Australia: megalitres. Includes ale and stout. Does not include beverages with alcohol percentage less than 1.15.

Usage

```
BEER
```

Format

BEER is a univariate time series of length 476, start January 1956, end Aug 1995, frequency = 12

BEER Monthly production of beer in Australia

Source

R package tsdl <https://github.com/FinYang/tsdl>

Examples

```
data(BEER)
## maybe  tsp(BEER) ; plot(BEER)
```

---

bispeces `bispeces` *performs indirect bivariate spectral estimation of two series y1, y2 using lagwindows*

Description

`bispeces` performs indirect bivariate spectral estimation of two series y1, y2 using lagwindows

Usage

```
bispeces(y1, y2, q, win = "bartlett")
```

Arguments

`y1`	vector, the first time series
`y2`	vector, the second time series
`q`	number of covariances used for indirect spectral estimation
`win`	lagwindow (possible: "bartlett", "parzen", "tukey")

Value

out data frame with columns:

`f`	frequencies 0, 1/n, 2/n, ... (<= 1/2)
`coh`	estimated coherency at Fourier frequencies 0,1/n, ...
`ph`	estimated phase at Fourier frequencies 0,1/n, ...

Examples

```
data(ICECREAM)
y <- ICECREAM
out <- bispeces(y[,1],y[,2],8,win="bartlett")
```

`BLACKOUT` *Weekly number of births in New York*

Description

Weekly number of births in New York

Usage

```
BLACKOUT
```

Format

BLACKOUT is a univariate time series of length 313, 1961 – 1966

BLACKOUT Weekly numbers of births in New York

Source

Izenman, A. J., and Zabell, S. L. (1981) <https://www.sciencedirect.com/science/article/abs/pii/0049089X81900181>

Examples

```
data(BLACKOUT)
## maybe  tsp(BLACKOUT) ; plot(BLACKOUT)
```

BoxCox	BoxCox *determines the power of a Box-Cox transformation to stabilize the variance of a time series*

Description

BoxCox determines the power of a Box-Cox transformation to stabilize the variance of a time series

Usage

```
BoxCox(y, seg, Plot = FALSE)
```

Arguments

y	the series, a vector or a time series
seg	scalar, number of segments
Plot	logical, should a plot be produced?

Value

l scalar, the power of the Box-Cox transformation

Examples

```
data(INORDER)
lambda <-BoxCox(INORDER,6,Plot=FALSE)
```

COFFEE	*U.S. annual coffee consumption*

Description

U.S. annual coffee consumption

Usage

```
COFFEE
```

Format

COFFEE is a univariate time series of length 61; start 1910, frequency = 1

COFFEE annual coffee-consumption USA, logarithmic transformed

Source

R package tsdl <https://github.com/FinYang/tsdl>

Examples

```
data(COFFEE)
## maybe  tsp(COFFEE) ; plot(COFFEE)
```

`DAX` *Market value of DAX*

Description

Market value of DAX

Usage

```
DAX
```

Format

DAX is a multivariate time series of length 12180 and 4 variables

DAY Day of the week

MONTH Month

Year Year

DAX30 Market value

Examples

```
data(DAX)
## maybe  tsp(DAX) ; plot(DAX)
```

`DIABETES` *Incidences of insulin-dependent diabetes mellitus*

Description

Incidences of insulin-dependent diabetes mellitus

Usage

```
DIABETES
```

Format

DIABETES is a univariate time series of length 72, start January 1979, frequency = 12

DIABETES Incidences of insulin-dependent diabetes mellitus

Source

Waldhoer, T., Schober, E. and Tuomilehto, J. (1997) <https://www.sciencedirect.com/science/ article/abs/pii/S0895435696003344>

Examples

```
data(DIABETES)
## maybe  tsp(DIABETES) ; plot(DIABETES)
```

DOMINANCE *Running yield of public bonds in Austria and Germany*

Description

Running yield of public bonds in Austria and Germany

Usage

```
DOMINANCE
```

Format

DOMINANCE is a bivariate time series of length 167:

X Interest rate Germany

Y Interest rate Austria

Source

Jaenicke, J. and Neck, R. (1996) <https://doi.org/10.17713/ajs.v25i2.555>

Examples

```
data(DOMINANCE)
## maybe  tsp(DOMINANCE) ; plot(DOMINANCE)
```

dynspecest — `dynspecest` *performs a dynamic spectrum estimation*

Description

`dynspecest` performs a dynamic spectrum estimation

Usage

```
dynspecest(y, nseg, nf, e, theta = 0, phi = 15, d, Plot = FALSE)
```

Arguments

`y`	time series or vector
`nseg`	number of segments for which the spectrum is estimated
`nf`	number of equally spaced frequencies
`e`	equal bandwidth
`theta`	azimuthal viewing direction, see R function persp
`phi`	colatitude viewing direction, see R function persp
`d`	a value to vary the strength of the perspective transformation, see R function persp
`Plot`	logical, schould a plot be generated?

Value

out list with components

`f`	frequencies, vector of length nf
`t`	time, vector of length nseg
`spec`	the spectral estimates, (nf,nt)-matrix

Examples

```
data(IBM)
y <- diff(log(IBM))
out <- dynspecest(y,60,50,0.2,theta=0,phi=15,d=1,Plot=FALSE)
```

ENGINES — *Number of incoming orders for engines*

Description

Number of incoming orders for engines

Usage

```
ENGINES
```

Format

ENGINES is a univariate time series of length 188, start January 1972 frequency = 12

ENGINES Incoming orders for enginesn

Examples

```
data(ENGINES)
## maybe  tsp(ENGINES) ; plot(ENGINES)
```

FINANCE — *Portfolio-Insurance-Strategies*

Description

Portfolio-Insurance-Strategies

Usage

```
FINANCE
```

Format

FINANCE is a multivariate time series of length 7529:

CPPI first Portfolio-Insurance-Strategy

TIPP second Portfolio-Insurance-Strategy

StopLoss third Portfolio-Insurance-Strategy

SyntheticPut fourth Portfolio-Insurance-Strategy

CASH money market investment

Source

Dichtl, H. and Drobetz, W. (2011) <doi:10.1016/j.jbankfin.2010.11.012>

Examples

```
data(FINANCE)
## maybe  tsp(FINANCE) ; plot(FINANCE)
```

GDP *Germany's gross domestic product adjusted for price changes*

Description

Germany's gross domestic product adjusted for price changes

Usage

```
GDP
```

Format

GDP is a univariate time series of length 159, start January 1970, frequency = 4

GDP Gross domestic product adjusted for price changes

Source

<https://www-genesis.destatis.de/genesis//online?operation=table&code=81000-0002&levelindex=0&levelid=15837501323

Examples

```
data(GDP)
## maybe  tsp(GDP) ; plot(GDP)
```

GDPORIG *Germany's gross domestic product, values of Laspeyres index to base 2000*

Description

Germany's gross domestic product, values of Laspeyres index to base 2000

Usage

```
GDPORIG
```

Format

GDPORIG is a univariate time series of length 159, start January 1970, frequency = 4

GDPORIG gross domestic product, values of Laspeyres index to the base 2000

Source

<https://www-genesis.destatis.de/genesis//online?operation=table&code=81000-0002&levelindex=0&levelid=15837501323

Examples

```
data(GDPORIG)
## maybe  tsp(GDPORIG) ; plot(GDPORIG)
```

`Grangercaus` — `Grangercaus` *determines three values of BIC from a twodimensional VAR process*

Description

`Grangercaus` determines three values of BIC from a twodimensional VAR process

Usage

```
Grangercaus(x, y, p)
```

Arguments

`x`	first time series
`y`	second time series
`p`	maximal order of VAR process

Value

out list with components

`BIC`	vector of length 3:

BIC1	minimum aic value for all possible lag structures
BIC2	minimum aic value when Y is not included as regressor in the equation for X
BIC3	minimum aic value when X is not included as regressor in the equation for Y

`out1`	output of function lm for regression equation for x-series
`out2`	output of function lm for regression equation for y-series

Examples

```
data(ICECREAM)
out <- Grangercaus(ICECREAM[,1],ICECREAM[,2],3)
```

HAC — *HAC Covariance Matrix Estimation* `HAC` *computes the central quantity (the meat) in the HAC covariance matrix estimator, also called sandwich estimator. HAC is the abbreviation for "heteroskedasticity and autocorrelation consistent".*

Description

HAC Covariance Matrix Estimation `HAC` computes the central quantity (the meat) in the HAC covariance matrix estimator, also called sandwich estimator. HAC is the abbreviation for "heteroskedasticity and autocorrelation consistent".

Usage

```
HAC(mcond, method = "Bartlett", bw)
```

Arguments

`mcond`	a q-dimensional multivariate time series. In the case of OLS regression with q regressors mcond contains the series of the form regressor*residual (see example below).
`method`	kernel function, choose between "Truncated", "Bartlett", "Parzen", "Tukey-Hanning", "Quadratic Spectral".
`bw`	bandwidth parameter, controls the number of lags considered in the estimation.

Value

mat a (q,q)-matrix

Source

Heberle, J. and Sattarhoff, C. (2017) <doi:10.3390/econometrics5010009> "A Fast Algorithm for the Computation of HAC Covariance Matrix Estimators"

Examples

```
data(MUSKRAT)
y <- ts(log10(MUSKRAT))
n <- length(y)
t <- c(1:n)
t2 <- t^2
out2 <- lm(y ~ t +t2)
mat_xu <- matrix(c(out2$residuals,t*out2$residuals, t2*out2$residuals),nrow=62,ncol=3)
hac <- HAC(mat_xu, method="Bartlett", 4)

mat_regr<- matrix(c(rep(1,62),t,t2),nrow=62,ncol=3)
mat_q <- t(mat_regr)%*%mat_regr/62
```

```
vcov_HAC <- solve(mat_q)%*%hac%*%solve(mat_q)/62
# vcov_HAC is the HAC covariance matrix estimation for the OLS coefficients.
```

HEARTBEAT *Cardiac frequency of a patient*

Description

Cardiac frequency of a patient

Usage

```
HEARTBEAT
```

Format

HEARTBEAT is a univariate time series of length 30:

HEARTBEAT cardiac frequency of a patient

Examples

```
data(HEARTBEAT)
## maybe  tsp(HEARTBEAT) ; plot(HEARTBEAT)
```

HSV *HSV's position in the first German soccer league*

Description

HSV's position in the first German soccer league

Usage

```
HSV
```

Format

HSV is a univariate time series of length 47:

HSV HSV's position in the first German soccer league

Source

<https://www.transfermarkt.de/hamburger-sv/platzierungen/verein/41>

Examples

```
data(HSV)
## maybe  tsp(HSV) ; plot(HSV)
```

IBM *IBM's stock price*

Description

IBM's stock price

Usage

```
IBM
```

Format

IBM is a univariate time series of length 369, start 17 May 1961

IBM IBM's daily stock price

Source

Box, G. E. P. and Jenkins, G. M. (1970, ISBN: 978-0816210947) "Time series analysis: forecasting and control"

Examples

```
data(IBM)
## maybe  tsp(IBM) ; plot(IBM)
```

ICECREAM *Temperature and consumption of ice cream*

Description

Temperature and consumption of ice cream

Usage

```
ICECREAM
```

Format

ICECREAM is a bivariate time series of length 160:

ICE consumption of ice cream

TEMP Temperature in Fahrenheit degrees

Source

Hand, D. J., et al. (1994, ISBN: 9780412399206) "A Handbook of Small Data Sets"

Examples

```
data(ICECREAM)
## maybe  tsp(ICECREAM) ; plot(ICECREAM)
```

INORDER *Income orders of a company*

Description

Income orders of a company

Usage

```
INORDER
```

Format

INORDER is a univariate time series of length 237, start January 1968, frequency =12

INORDER Income orders of a company

Examples

```
data(INORDER)
## maybe  tsp(INORDER) ; plot(INORDER)
```

---

interpol `interpol` *help function for missls*

Description

`interpol` help function for missls

Usage

```
interpol(rho, xcent)
```

Arguments

`rho`	autocorrelation function
`xcent`	centered time series

Value

z new version of xcent

`kweightsHAC` *`kweightsHAC` help function for HAC*

Description

`kweightsHAC` help function for HAC

Usage

```
kweightsHAC(
  kernel = c("Truncated", "Bartlett", "Parzen", "Tukey-Hanning", "Quadratic Spectral"),
   dimN,
   bw
)
```

Arguments

`kernel`	kernel function, choose between "Truncated", "Bartlett", "Parzen", "Tukey-Hanning", "Quadratic Spectral".
`dimN`	number of observations
`bw`	bandwidth parameter

Value

ww weights

`L921` *Subsoil water level and precipitation at pilot well L921*

Description

Subsoil water level and precipitation at pilot well L921

Usage

```
L921
```

Format

L921 is a trivariate time series of length 335:

T Day

Y Water level

Z Supplemented water level

Examples

```
data(L921)
## maybe  tsp(L921) ; plot(L921)
```

---

lagwinba — lagwinba *Bartlett's Lag-window for indirect spectrum estimation*

Description

`lagwinba` Bartlett's Lag-window for indirect spectrum estimation

Usage

```
lagwinba(NL)
```

Arguments

`NL`	number of lags used for estimation

Value

win vector, one-sided weights

Examples

```
win <-lagwinba(5)
```

---

lagwinpa — lagwinpa *Parzen's Lag-window for indirect spectrum estimation*

Description

`lagwinpa` Parzen's Lag-window for indirect spectrum estimation

Usage

```
lagwinpa(NL)
```

Arguments

`NL`	number of lags used for estimation

Value

win vector, one-sided weights

Examples

```
win <- lagwinpa(5)
```

`lagwintu` — `lagwintu` *Tukey's Lag-window for indirect spectrum estimation*

Description

`lagwintu` Tukey's Lag-window for indirect spectrum estimation

Usage

```
lagwintu(NL)
```

Arguments

`NL`	number of lags used for estimation

Value

win vector, one-sided weights

Examples

```
win <- lagwintu(5)
```

`ldrec` — `ldrec` *does Levinson-Durbin recursion for determing all coefficients a(i,j)*

Description

`ldrec` does Levinson-Durbin recursion for determing all coefficients a(i,j)

Usage

```
ldrec(a)
```

Arguments

`a`	(p+1,1)-vector of acf of a time series: acov(0),...,acov(p) or 1,acor(1),..,acor(p)

Value

mat (p,p+2)-matrix, coefficients in lower triangular, pacf in colum p+2 and Q(p) in colum p+1

Examples

```
data(HEARTBEAT)
a <- acf(HEARTBEAT,5,plot=FALSE)
mat <- ldrec(a$acf)
```

LITH — *Daily subsoil water level and precipitation at pilot well Lith*

Description

Daily subsoil water level and precipitation at pilot well Lith

Usage

```
LITH
```

Format

LITH is a bivariate time series of length 1347:

N precipitation amount

G water level

Examples

```
data(LITH)
## maybe  tsp(LITH) ; plot(LITH)
```

LjungBoxPierceTest — `LjungBoxPierceTest` *determines the test statistic and p values for several lags for a residual series*

Description

`LjungBoxPierceTest` determines the test statistic and p values for several lags for a residual series

Usage

```
LjungBoxPierceTest(y, n.par = 0, maxlag = 48)
```

Arguments

`y`	the series of residuals, a vector or a time series
`n.par`	number of parameters which had been estimated
`maxlag`	maximal lag up to which the test statistic is computed, default is maxlag = 48

Value

BT matrix with columns: lags, degrees of freedom, test statistic, p-value

Examples

```
data(COFFEE)
out <- arima(COFFEE,order=c(1,0,0))
BT <- LjungBoxPierceTest(out$residuals,1,20)
```

`LUHORMONE` *Level of Luteinzing hormone of a cow*

Description

Level of Luteinzing hormone of a cow

Usage

```
LUHORMONE
```

Format

LUHORMONE is a bivariate time series of length 29:

T Time in minutes

X Level of the Luteinzing-hormone

`LYNX` *Annual lynx trappings in a region of North-West Canada. Taken from Andrews and Herzberg (1985).*

Description

Annual lynx trappings in a region of North-West Canada. Taken from Andrews and Herzberg (1985).

Usage

```
LYNX
```

Format

LYNX is a univariate time series of length 114; start 1821 frequency = 1

LYNX annual lynx trappings in a region of North-west Canada

Source

Andrews, D. F. and Herzberg, A. M. (1985) "Data" <https://www.springer.com/gp/book/9781461295631>

Examples

```
data(LYNX)
## maybe  tsp(LYNX) ; plot(LYNX)
```

LYNXHARE *Size of populations of lynxes and snow hares*

Description

Size of populations of lynxes and snow hares

Usage

```
LYNXHARE
```

Format

LYNXHARE is a simulated bivariate time series from a VAR[1]-model of length 100:

X Number of lynxes

Y Number of snow hares

Examples

```
data(LYNXHARE)
```

MAUNALOA *Atmospheric CO2 concentrations (ppmv) derived from in situ air samples collected at Mauna Loa Observatory, Hawaii*

Description

Atmospheric CO2 concentrations (ppmv) derived from in situ air samples collected at Mauna Loa Observatory, Hawaii

Usage

```
MAUNALOA
```

Format

MAUNALOA is a univariate time series of length 735; start March 1958, frequency = 12

MAUNALOA CO2-concentration at Mauna Loa

Source

Keeling, C. D. , Piper, S. C., Bacastow, R. B., Wahlen, M. , Whorf, T. P., Heimann, M., and Meijer, H. A. (2001) <https://library.ucsd.edu/dc/object/bb3859642r>

Examples

```
data(MAUNALOA)
## maybe  tsp(MAUNALOA) ; plot(MAUNALOA)
```

`MDAX` *Stock market price of MDAX*

Description

Stock market price of MDAX

Usage

```
MDAX
```

Format

MDAX is a multivariate time series of length 6181 and 4 variables

DAY Day of the week

MONTH Month

YEAR Year

MDAX Opening stock market price

Source

<https://www.onvista.de/index/MDAX-Index-323547>

Examples

```
data(MDAX)
## maybe  tsp(MDAX) ; plot(MDAX[,3])
```

MELANOM — *Melanoma incidence in Connecticut*

Description

Melanoma incidence in Connecticut

Usage

```
MELANOM
```

Format

MELANOM is a multivariate time series of length 45 and 3 variables

POP Population

RATE Incidence

SUN Sunspots

Source

Andrews, D. F. and Herzberg, A. M. (1985) "Data" <https://www.springer.com/gp/book/9781461295631>

Examples

```
data(MELANOM)
## maybe  tsp(MELANOM) ; plot(MELANOM[,-1])
```

missar — `missar` *Substitution of missing values in a time series by conditional exspectations of AR(p) models*

Description

`missar` Substitution of missing values in a time series by conditional exspectations of AR(p) models

Usage

```
missar(x, p, iterout = 0)
```

Arguments

`x`	vector, the time series
`p`	integer, the maximal order of ar polynom 0 < p < 18,
`iterout`	if = 1, iteration history is printed

Value

out list with elements

`a`	(p,p)-matrix, estimated ar coefficients for ar-models
`y`	(n,1)-vector, completed time series
`iterhist`	matrix, NULL or the iteration history

Source

Miller R.B., Ferreiro O. (1984) <doi.org/10.1007/978-1-4684-9403-7_12> "A Strategy to Complete a Time Series with Missing Observations"

Examples

```
data(HEARTBEAT)
x <- HEARTBEAT
x[c(20,21)] <- NA
out <- missar(x,2)
```

---

missls — *missls substitutes missing values in a time series using the LS approach with ARMA models*

Description

`missls` substitutes missing values in a time series using the LS approach with ARMA models

Usage

```
missls(x, p = 0, tol = 0.001, theo = 0)
```

Arguments

`x`	vector, the time series
`p`	integer, the order of polynom alpha(B)/beta(B)
`tol`	tolerance that can be set; it enters via tol*sd(x,na.rm=TRUE)
`theo`	(k,1)-vector, prespecified Inverse ACF, IACF (starting at lag 1)

Value

y completed time series

Source

S. R. Brubacher and G. Tunnicliffe Wilson (1976) <https://www.jstor.org/stable/2346678> "Interpolating Time Series with Application to the Estimation of Holiday Effects on Electricity Demand Journal of the Royal Statistical Society"

Examples

```
data(HEARTBEAT)
x <- HEARTBEAT
x[c(20,21)] <- NA
out <-  missls(x,p=2,tol=0.001,theo=0)
```

---

moveav — moveav *smoothes a time series by moving averages*

Description

moveav smoothes a time series by moving averages

Usage

```
moveav(y, q)
```

Arguments

y	the series, a vector or a time series
q	scalar, span of moving average

Value

g vector, smooth component

Examples

```
data(GDP)
g <- moveav(GDP,12)
 plot(GDP) ; lines(g,col="red")
```

---

movemed — movemed *smoothes a time series by moving medians*

Description

movemed smoothes a time series by moving medians

Usage

```
movemed(y, q)
```

Arguments

y	the series, a vector or a time series
q	scalar, span of moving median

Value

g vector, smooth component

Examples

```
data(BIP)
g <- movemed(GDP,12)
 plot(GDP) ; t <- seq(from = 1970, to = 2009.5,by=0.25) ; lines(t,g,col="red")
```

MUSKRAT — *Annual trade of muskrat pelts*

Description

Annual trade of muskrat pelts

Usage

```
MUSKRAT
```

Format

MUSKRAT is a univariate time series of length 62; start 1848, frequency = 1

MUSKRAT annual trade of muskrat pelts

Source

<https://archive.uea.ac.uk/~gj/book/data/mink.dat>

Examples

```
data(MUSKRAT)
## maybe  tsp(MUSKRAT) ; plot(MUSKRAT)
```

outidentify — *outidentify performs one iteration of Wei's iterative procedure to identify impact, locations and type of outliers in arma processes*

Description

`outidentify` performs one iteration of Wei's iterative procedure to identify impact, locations and type of outliers in arma processes

Usage

```
outidentify(x, object, alpha = 0.05, robust = FALSE)
```

Arguments

`x`	vector, the time series
`object`	output of a model fit with the function arima (from stats)
`alpha`	the level of the tests for deciding which value is to be considered an outlier
`robust`	logical, should the standard error be computed robustly?

Value

out list with elements

`outlier`	matrix with time index (ind), type of outlier (1 = AO, 2 = IO) and value of test statistic (lambda)
`arima.out`	output of final arima model where the outliers are incorporated as fixed regressors

Examples

```
data(SPRUCE)
out <- arima(SPRUCE,order=c(2,0,0))
out2 <- outidentify(SPRUCE,out,alpha=0.05, robust = FALSE)
```

OXYGEN — *Amount of an Oxygen isotope*

Description

Amount of an Oxygen isotope

Usage

```
OXYGEN
```

Format

OXYGEN is a matrix with 164 rows and 2 columns

T Time

D DELTA18O

Source

Belecher, J., Hampton, J. S., and Tunnicliffe Wilson, T. (1994, ISSN: 1369-7412) "Parameterization of Continuous Time Autoregressive Models for Irregularly Sampled Time Series Data"

Examples

```
data(OXYGEN)
## maybe   plot(OXYGEN[,1],OXYGEN[,2],type="l"); rug(OXYGEN[,1])
```

`pacfmat` — *`pacfmat` sequence of partial autocorrelation matrices and related statistics for a multivariate time series*

Description

`pacfmat` sequence of partial autocorrelation matrices and related statistics for a multivariate time series

Usage

```
pacfmat(y, lag.max)
```

Arguments

`y`	multivariate time series
`lag.max`	maximum number of lag

Value

out list with components:

`M`	array with matrices of partial autocovariances divided by their standard error
`M1`	array with indicators if partial autocovariances are significantly greater (+), lower (-) than the critical value or insignificant (.)
`R`	array with matrices of partial autocovariances
`S`	matrix of diagonals of residual covariances (row-wise)
`Test`	test statistic
`pval`	p value of test

Examples

```
data(ICECREAM)
out <- pacfmat(ICECREAM,7)
```

PAPER *Two measurements at a paper machine*

Description

Two measurements at a paper machine

Usage

```
PAPER
```

Format

PAPER is a bivariate time series of length 160

H High

W Weight

Source

Janacek, G. J. & Swift, L. (1993, ISBN: 978-0139184598) "Time Series: Forecasting, Simulation, Applications"

Examples

```
data(PAPER)
## maybe  tsp(PAPER) ; plot(PAPER)
```

---

periodogram `periodogram` *determines the periodogram of a time series*

Description

`periodogram` determines the periodogram of a time series

Usage

```
periodogram(y, nf, ACF = FALSE, type = "cov")
```

Arguments

`y`	(n,1) vector, the time series or an acf at lags 0,1,...,n-1
`nf`	scalar, the number of equally spaced frequencies
`ACF`	logical, FALSE, if y is ts, TRUE, if y is acf
`type`	c("cov","cor"), area under spectrum, can be variance or normed to 1.

Value

out (floor(nf/2)+1,2) matrix, the frequencies and the periodogram

Examples

```
data(WHORMONE)
out <-periodogram(WHORMONE,50,ACF=FALSE,type="cov")
```

`periodotest` *`periodotest` computes the p-value of the test for a hidden periodicity*

Description

`periodotest` computes the p-value of the test for a hidden periodicity

Usage

```
periodotest(y)
```

Arguments

`y`	vector, the time series

Value

pval the p-value of the test

Examples

```
data(PIGPRICE)
y <- PIGPRICE
out <- stl(y,s.window=6)
e <- out$time.series[,3]
out <- periodotest(e)
```

perwinba — perwinba *Bartlett-Priestley window for direct spectral estimation*

Description

perwinba Bartlett-Priestley window for direct spectral estimation

Usage

```
perwinba(e, n)
```

Arguments

e	equal bandwidth (at most n frequencies are used for averaging)
n	length of time series

Value

w weights (symmetric)

Examples

```
data(WHORMONE)
w <- perwinba(0.1,length(WHORMONE))
```

perwinpa — perwinpa *Parzen's window for direct spectral estimation*

Description

perwinpa Parzen's window for direct spectral estimation

Usage

```
perwinpa(e, n)
```

Arguments

e	equal bandwidth (at most n frequencies are used for averaging)
n	length of time series

Value

w weights (symmetric)

Examples

```
data(WHORMONE)
w <- perwinpa(0.1,length(WHORMONE))
```

---

pestep — `pestep` *help function for missar*

Description

`pestep` help function for missar

Usage

```
pestep(f, xt)
```

Arguments

`f`	IACF, inverse ACF
`xt`	segment of the time series

Value

xt new version of xt

PIGPRICE — *Monthly prices for pigs*

Description

Monthly prices for pigs

Usage

```
PIGPRICE
```

Format

PIGPRICE is a univariate time series of length 240; start January 1894, frequency =12

PIGPRICE Monthly prices for pigs

Source

Hanau, A. (1928) "Die Prognose der Schweinepreise"

Examples

```
data(PIGPRICE)
## maybe  tsp(PIGPRICE) ; plot(PIGPRICE)
```

---

polymake *polymake generates the coefficients of an AR process given the zeros of the characteristic polynomial. The norm of the roots must be greater than one for stationary processes.*

Description

polymake generates the coefficients of an AR process given the zeros of the characteristic polynomial. The norm of the roots must be greater than one for stationary processes.

Usage

```
polymake(r)
```

Arguments

r	vector, the zeros of the characteristic polynomial

Value

C coefficients (a[1],a[2],...,a[p]) of the polynomial 1 - a[1]z -a[2]z^2 -...- a[p]z^p

Examples

```
C <- polymake(c(2,-1.5,3))
```

PPDEMAND *Peak power demand in Berlin*

Description

Peak power demand in Berlin

Usage

```
PPDEMAND
```

Format

PPDEMAND is a univariate time series of length 37; start 1955, frequency = 1

PPDEMAND annual peak power demand in Berlin, Megawatt

Source

Fiedler, H. (1979) "Verschiedene Verfahren zur Prognose des des Stromspitzenbedarfs in Berlin (West)"

Examples

```
data(PPDEMAND)
## maybe  tsp(PPDEMAND) ; plot(PPDEMAND)
```

`PRODINDEX` *Production index of manufacturing industries*

Description

Production index of manufacturing industries

Usage

```
PRODINDEX
```

Format

PRODINDEX is a univariate time series of length 119:

PRODINDEX Production index of manufacturing industries

Source

Statistisches Bundesamt (2009) <https://www-genesis.destatis.de/genesis/online>

Examples

```
data(PRODINDEX)
## maybe  tsp(PRODINDEX) ; plot(PRODINDEX)
```

psifair — `psifair` *is a psi-function for robust estimation*

Description

`psifair` is a psi-function for robust estimation

Usage

```
psifair(u)
```

Arguments

u	vector

Value

out transformed vector

Examples

```
out <- psifair(c(3.3,-0.7,2.1,1.8))
```

psihuber — `psihuber` *is a psi-function for robust estimation*

Description

`psihuber` is a psi-function for robust estimation

Usage

```
psihuber(u)
```

Arguments

u	vector

Value

out transformed vector

Examples

```
out <- psihuber(c(3.3,-0.7,2.1,1.8))
```

RAINFALL *Annual amount of rainfall in Los Angeles*

Description

Annual amount of rainfall in Los Angeles

Usage

```
RAINFALL
```

Format

RAINFALL is a univariate time series of length 119; start 1878, frequency = 1

RAINFALL Amount of rainfall in Los Angeles

Source

LA Times (January 28. 1997)

Examples

```
data(RAINFALL)
## maybe  tsp(RAINFALL) ; plot(RAINFALL)
```

REDWINE *Monthly sales of Australian red wine (1000 l)*

Description

Monthly sales of Australian red wine (1000 l)

Usage

```
REDWINE
```

Format

REDWINE is a univariate time series of length 187; start January 1980, frequency =12

REDWINE Monthly sales of Australian red wine

Source

R package tsdl <https://github.com/FinYang/tsdl>

Examples

```
data(REDWINE)
## maybe  tsp(REDWINE) ; plot(REDWINE)
```

---

robsplinedecomp *robsplinedecomp decomposes a vector into trend, season and irregular component by robustified spline approach; a time series attribute is lost*

Description

robsplinedecomp decomposes a vector into trend, season and irregular component by robustified spline approach; a time series attribute is lost

Usage

```
robsplinedecomp(y, d, alpha, beta, Plot = FALSE)
```

Arguments

y	the series, a vector or a time series
d	seasonal period
alpha	smoothing parameter for trend component (the larger alpha is, the smoother will the smooth component g be)
beta	smoothing parameter for seasonal component
Plot	logical, should a plot be produced?

Value

out list with the elements trend, season, residual

Examples

```
data(GDP)
out  <- robsplinedecomp(GDP,4,2,10,Plot=FALSE)
```

RS — RS *rescaled adjusted range statistic*

Description

RS rescaled adjusted range statistic

Usage

```
RS(x, k)
```

Arguments

x	univariate time series
k	length of the segments for which the statistic is computed. Starting with t=1, the segments do not overlap.

Value

(l,3)-matrix, 1. column: k, second column: starting time of segment, third column: value of RS statistic.

Examples

```
data(TREMOR)
R <- RS(TREMOR,10)
```

SALES — *Monthly sales of a company*

Description

Monthly sales of a company

Usage

```
SALES
```

Format

SALES is a univariate time series of length 77:

y monthly sales of a company

Source

Newton, H. J. (1988, ISBN: 978-0534091989): "TIMESLAB: A time series analysis laboraty"

Examples

```
data(SALES)
## maybe  tsp(SALES) ; plot(SALES)
```

SCHAUINSLAND — *CO2-Concentration obtained in Schauinsland, Germany*

Description

CO2-Concentration obtained in Schauinsland, Germany

Usage

```
SCHAUINSLAND
```

Format

SCHAUINSLAND is a univariate time series of length 72:

SCHAUINSLAND CO2-Concentration obtained in Schauinsland

Source

<http://cdiac.ornl.gov/trends/co2/uba/uba-sc.html>

Examples

```
data(SCHAUINSLAND)
## maybe  tsp(SCHAUINSLAND) ; plot(SCHAUINSLAND)
```

---

simpledecomp — `simpledecomp` *decomposes a vector into trend, season and irregular component by linear regression approach*

Description

`simpledecomp` decomposes a vector into trend, season and irregular component by linear regression approach

Usage

```
simpledecomp(y, trend = 0, season = 0, Plot = FALSE)
```

Arguments

`y`	the series, a vector or a time series
`trend`	order of trend polynomial
`season`	period of seasonal component
`Plot`	logical, should a plot be produced?

Value

out: (n,3) matrix

`1. column`	smooth component
`2. column`	seasonal component
`3. column`	irregular component

Examples

```
data(GDP)
out  <- simpledecomp(GDP,trend=3,season=4,Plot=FALSE)
```

`smoothls` — *`smoothls` smoothes a time series by Whittaker graduation. The function depends on the package Matrix.*

Description

`smoothls` smoothes a time series by Whittaker graduation. The function depends on the package Matrix.

Usage

```
smoothls(y, beta = 0)
```

Arguments

`y`	the series, a vector or a time series
`beta`	smoothing parameter >=0 (the larger beta is, the smoother will g be)

Value

g vector, smooth component

Examples

```
data(GDP)
g <- smoothls(GDP,12)

 plot(GDP)
 t <- seq(from = tsp(GDP)[1], to = tsp(GDP)[2],by=1/tsp(GDP)[3]) ; lines(t,g,col="red")
```

`smoothrb` *smoothes a time series robustly by using Huber's psi-function. The initialisation uses a moving median.*

Description

`smoothrb` smoothes a time series robustly by using Huber's psi-function. The initialisation uses a moving median.

Usage

```
smoothrb(y, beta = 0, q = NA)
```

Arguments

`y`	the series, a vector or a time series
`beta`	smoothing parameter (The larger beta is, the smoother will the smooth component g be.)
`q`	length of running median which is used to get initial values

Value

g vector, the smooth component

Examples

```
data(GDP)
g  <- smoothrb(GDP,8,q=8)

 plot(GDP) ; t <- seq(from = 1970, to = 2009.5,by=0.25) ; lines(t,g,col="red")
```

`specest` *direct spectral estimation of series y using periodogram window win*

Description

`specest` direct spectral estimation of series y using periodogram window win

Usage

```
specest(y, nf, e, win = c("perwinba", "perwinpa"), conf = 0, type = "cov")
```

Arguments

`y`	(n,1) vector, the ts
`nf`	number of equally spaced frequencies
`e`	equal bandwidth, must be 0 <= e <0.5
`win`	string, name of periodogram window (possible: "perwinba", "perwinpa")
`conf`	scalar, the level for confidence intervals
`type`	c("cov","cor"), area under spectrum is variance or is normed to 1.

Value

est (nf+1,2)- or (nf+1,4)-matrix:

`column 1:`	frequencies 0, 1/n, 2/n, ..., m/n
`column 2:`	the estimated spectrum
`column 3+4:`	the confidence bounds

Examples

```
data(WHORMONE)
est <- specest(WHORMONE,50,0.05,win = c("perwinba","perwinpa"),conf=0,type="cov")
```

---

specplot — `specplot` *plot of spectral estimate*

Description

`specplot` plot of spectral estimate

Usage

```
specplot(s, Log = FALSE)
```

Arguments

`s`	(n,2) or (n,4) matrix, output of specest
`Log,`	logical, if TRUE, the logs of the spectral estimates are shown

Examples

```
data(WHORMONE)
est <- specest(WHORMONE,50,0.05,win = c("perwinba","perwinpa"),conf=0,type="cov")
specplot(est,Log=FALSE)
```

`splinedecomp` *`splinedecomp` decomposes a time series into trend, season and irregular component by spline approach.*

Description

`splinedecomp` decomposes a time series into trend, season and irregular component by spline approach.

Usage

```
splinedecomp(x, d, alpha, beta, Plot = FALSE)
```

Arguments

`x`	the series, a vector or a time series
`d`	seasonal period
`alpha`	smoothing parameter for trend component (The larger alpha is, the smoother will the smooth component g be.)
`beta`	smoothing parameter for seasonal component
`Plot`	logical, should a plot be produced?

Value

out (n,3) matrix:

`1. column`	smooth component
`2. column`	seasonal component
`3. column`	irregular component

Examples

```
data(GDP)
out  <- splinedecomp(GDP,4,2,4,Plot=FALSE)
```

`SPRUCE` *Annual logging of spruce wood.*

Description

Annual logging of spruce wood.

Usage

```
SPRUCE
```

Format

SPRUCE is a univariate time series of length 42:

SPRUCE Annual logging of spruce wood

Examples

```
data(SPRUCE)
## maybe  tsp(SPRUCE) ; plot(SPRUCE)
```

`statcheck` *`statcheck` determines the means, standard deviations and acf's of segmets of a time series and plots the acf's for the segments.*

Description

`statcheck` determines the means, standard deviations and acf's of segmets of a time series and plots the acf's for the segments.

Usage

```
statcheck(y, d)
```

Arguments

`y`	the series, a vector or a time series
`d`	scalar, number of segments

Value

out list with components:

`ms`	matrix with means and standard deviations of the segments
`ac`	matrix with acf's, the first column: acf of the series, the others: acf's of the segments

Examples

```
data(COFFEE)
out <- statcheck(COFFEE,4)
```

---

subsets	`subsets` *determines all subsets of a set of n elements (labelled by 1,2,...,n).*

Description

`subsets` determines all subsets of a set of n elements (labelled by 1,2,...,n).

Usage

```
subsets(n)
```

Arguments

`n`	scalar, integer >= 1

Value

mat (2^n,n)-matrix, each row gives the membership indicators of the elements 1,2,...,n

Examples

```
out <- subsets(4)
```

---

symplot	`symplot` *produces a symmetry plot*

Description

`symplot` produces a symmetry plot

Usage

```
symplot(y)
```

Arguments

`y`	the series, a vector or a time series

Examples

```
data(LYNX)
symplot(LYNX)
```

---

taper *taper* `taper` *taper modification of a time series*

Description

`taper` taper modification of a time series

Usage

```
taper(y, part)
```

Arguments

`y`	the time series
`part`	scalar, 0 <= part <= 0.5, part of modification (at each end of y)

Value

tp tapered time series

Examples

```
data(WHORMONE)
out <-taper(WHORMONE,0.3)

plot(WHORMON)
lines(out,col="red")
```

`TAXES` *Monthly community taxes in Germany (billions EURO)*

Description

Monthly community taxes in Germany (billions EURO)

Usage

```
TAXES
```

Format

TAXES is a univariate time series of length 246; start January 1999, frequency = 12

TAXES monthly community taxes in Germany

Source

<https://www-genesis.destatis.de/genesis/online?operation=previous&levelindex=1&step=1&titel=Tabellenaufbau&levelid=

Examples

```
data(TAXES)
## maybe  tsp(TAXES) ; plot(TAXES)
```

`TREERING` *Mean thickness of annual tree rings*

Description

Mean thickness of annual tree rings

Usage

```
TREERING
```

Format

TREERING is a multivariate time series of length 66 with 3 variables:

THICK mean thickness of annual tree rings

TEMP mean temperature of the year

RAIN amount of rain of the year

Source

<https://ltrr.arizona.edu/>

Examples

```
data(TREERING)
## maybe  tsp(TREERING) ; plot(TREERING)
```

TREMOR *Measurements of physiological tremor*

Description

Measurements of physiological tremor

Usage

```
TREMOR
```

Format

TREMOR is a univariate time series of length 400.

TREMOR Tremor

Examples

```
data(TREMOR)
## maybe  tsp(TREMOR) ; plot(TREMOR)
```

tsmat *tsmat constructs a (n-p+1,p) matrix from a time series where the first column is the shortened series y[p],...,y[n], the second is y[p-1],...,y[n-1], etc.*

Description

tsmat constructs a (n-p+1,p) matrix from a time series where the first column is the shortened series y[p],...,y[n], the second is y[p-1],...,y[n-1], etc.

Usage

```
tsmat(y, p)
```

Arguments

y	the series, a vector or a time series of length n
p	desired number of columns

Value

mat (n-p+1,p) matrix

Examples

```
out <- tsmat(c(1:20),4)
```

USAPOP *Population of USA*

Description

Population of USA

Usage

```
USAPOP
```

Format

USAPOP is a univariate time series of length 39; start 1630, frequency = 0.1

USAPOP Population of USA

Source

<https://www.worldometers.info/world-population/us-population/>

Examples

```
data(USAPOP)
## maybe  tsp(USAPOP) ; plot(USAPOP)
```

vartable `vartable` *determines table of variate differences*

Description

`vartable` determines table of variate differences

Usage

```
vartable(y, season)
```

Arguments

`y`	the series, a vector or a time series
`season`	scalar, period of seasonal component

Value

d matrix with ratios of variances for differend numbers of simple and seasonal differencing

Examples

```
data(GDP)
out <- vartable(GDP,4)
```

`WHORMONE` *Concentration of growth hormone of a bull*

Description

Concentration of growth hormone of a bull

Usage

```
WHORMONE
```

Format

WHORMONE is a univariate time series of length 97:

WHORMONE Concentration of growth hormone of a bull

Source

Newton, H. J. (1988, ISBN: 978-0534091989): "TIMESLAB: A time series analysis laboraty"

Examples

```
data(WHORMONE)
## maybe  tsp(WHORMONE) ; plot(WHORMONE)
```

`wntest` `wntest` *graphical test for white noise for a time series or a series of regression residuals*

Description

`wntest` graphical test for white noise for a time series or a series of regression residuals

Usage

```
wntest(e, a, k = 0)
```

Arguments

e	vector, the time series (k = 0) or residuals (k > 0)
a	scalar, level of significance
k	scalar >= 0, number of regressors used to compute e as residuals

Value

tp vector, value of test statistic and p-value

Examples

```
data(WHORMONE)
out <- wntest(WHORMONE,0.05,0)
```

Index