Package ‘dse’

Version 2020.2-1

Title Dynamic Systems Estimation (Time Series Package)

Description Tools for multivariate, linear, time-invariant, time series models. This includes ARMA and state-space representations, and methods for converting between them. It also includes simulation methods and several estimation functions. The package has functions for looking at model roots, stability, and forecasts at different horizons. The ARMA model representation is general, so that VAR, VARX, ARIMA, ARMAX, ARIMAX can all be considered to be special cases. Kalman filter and smoother estimates can be obtained from the state space model, and state-space model reduction techniques are implemented. An introduction and User’s Guide is available in a vignette.

Depends R (>= 2.5.0), tfplot

Imports tframe (>= 2007.5-3), stats, utils, graphics, grDevices, setRNG (>= 2004.4-1)

LazyLoad yes

License GPL-2


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dse-package

Dynamic Systems Estimation - Multivariate Time Series Package

Description

Functions for time series modeling, including multi-variate state-space and ARMA (VAR, ARIMA, ARIMAX) models.

Details

A Brief User's Guide is distributed with dse as a vignette. The package implements an R/S style object approach to time series modeling. This means that different model and data representations can be implemented with fairly simple extensions to the package.

The package includes methods for simulating, estimating, and converting among different model representations. These are mainly in dse. Package EvalEst has methods for studying estimation techniques and for examining the forecasting properties of models. There are also functions for forecasting and for evaluating the performance of forecasting models, as well as functions for evaluating model estimation techniques.

Package: dse
Depends: R, setRNG, tframe
License: free, see LICENSE file for details.
URL: http://tsanalysis.r-forge.r-project.org/

The main objects are:

**TSdata** time series input and output data structure
**TSmodel** a DSE model structure
**TSestModel** model, data and some estimation information

The main general methods are:
TSdata create, extract a DSE data structure
TSmodel create, extract a DSE model structure
simulate simulate a model to produce artificial data
toSS convert to a state-space model
toARMA convert to an ARMA model
ARMA construct an ARMA model
SS construct a state-space model
l evaluate a model with data
smoother calculate the smoothed state estimate

The main estimation methods are:
estVARXls estimate an ARMA model with least squares
estVARXar estimate an ARMA model with ar
estSSfromVARX calculate a state-space model from an estimated VAR model
bft a (usually) good “black-box” estimated model
estMaxLik estimate a model using maximum likelihood

The main diagnostic methods are:
checkResiduals autocorrelation diagnostics
informationTests calculate several information tests for a model
McMillanDegree calculate the McMillanDegree of a model
stability calculate the stability of a model
roots calculate the roots of a model

The methods for producing and evaluating forecasts are:
l evaluate a model with data (and simple forecasts)
forecast calculate forecasts
featherForecasts calculate forecasts starting at different periods
horizonForecasts calculate forecasts at different horizons
forecastCov calculate the covariance of forecasts
MonteCarloSimulations multiple simulations

The methods for evaluating estimation methods are:
EstEval evaluate estimation methods

The functions described in the Brief User’s Guide and examples in the help pages should work fairly reliably (since they are tested regularly), however, the code is distributed on an “as-is” basis. This is a compromise which allows me to make the software available with minimum effort. This software is not a commercial product. It is the by-product of ongoing research. Error reports, constructive suggestions, and comments are welcomed.
Usage

library("dse")
library("EvalEst")

References


See Also

TSdata, TSMmodel, TSEstModel.object

---

**addPlotRoots**

Add Model Roots to a plot

Description

Calculate and plot roots of a model.

Usage

addPlotRoots(v, pch='*', fuzz=0)
Arguments
v An object containing a TSmodel.
pch Character to use for plotting.
fuzz If non-zero then roots within fuzz distance are considered equal.

Value
The eigenvalues of the state transition matrix or the inverse of the roots of the determinant of the AR polynomial are returned invisibly.

Side Effects
The roots are added to an existing plot.

See Also
plot.roots

Examples
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
plot(roots(model))
addPlotRoots(toSS(model))
ARMA

constants NULL or a list of logical arrays with the same names as arrays above, indicating which elements should be considered constants.
description An arbitrary string.
names A list with elements input and output, each a vector of strings. Arguments input.names and output.names should not be used if argument names is used.
input.names A vector of strings.
output.names A vector of strings.
obj Any object.

Details

The ARMA model is defined by:
\[ A(L)y(t) = B(L)w(t) + C(L)u(t) + \text{TREND}(t) \]
where

- \( A \) (axpxp) is the auto-regressive polynomial array.
- \( B \) (bxpxp) is the moving-average polynomial array.
- \( C \) (cxpxm) is the input polynomial array. \( C \) should be NULL if there is no input.
- \( y \) is the \( p \) dimensional output data.
- \( u \) is the \( m \) dimensional control (input) data.
- \( \text{TREND} \) is a matrix the same dimension as \( y \), a \( p \)-vector (which gets replicated for each time period), or NULL.

This is sometime called a vector ARMA (VARMA) model, but the univariate case is also handled by this structure. VAR models are a special case where \( B(L) = I \). ARIMA models are also special cases where the polynomial arrays have unit roots, but these are not distinguished in a separate term as is sometimes done in other programs.

The name of last term, \( \text{TREND} \), is misleading. If it is NULL it is treated as zero. If it is a \( p \)-vector, then this constant vector is added to the the \( p \)-vector \( y(t) \) at each period. For a stable model this would give the none zero mean, and might more appropriately be called the constant or intercept rather than trend. If the model is for differenced data, then this mean is the trend of the undifferenced model. The more general case is when \( \text{TREND} \) is a time series matrix of the same dimension as \( y \). In this case it is added to \( y \). This allows for a very general deterministic component, which may or may not be a traditional trend.

By default, elements in parameter arrays are treated as constants if they are exactly 1.0 or 0.0, and as parameters otherwise. A value of 1.001 would be treated as a parameter, and this is the easiest way to initialize an element which is not to be treated as a constant of value 1.0. Any array elements can be fixed to constants by specifying the list constants. Arrays which are not specified in the list will be treated in the default way. An alternative for fixing constants is the function \text{fixConstants}.

The function \text{ARMA} sets up a model but does not estimate it. See \text{estVARXls} for one possibility for estimating VAR models and \text{estMaxLik} for one possibility for estimating ARMA models.

Value

An ARMA TSmodel
See Also

TSmodel, simulate.ARMA, fixConstants estVARXls estMaxLik

Examples

```r
mod1 <- ARMA(A=array(c(1,-.25,-.05), c(3,1,1)), B=array(1,c(1,1,1)))
AR <- array(c(1, .5, .3, 0, .2, .1, 0, .2, .05, 1, .5, .3) ,c(3,2,2))
VAR <- ARMA(A=AR, B=diag(1,2))
C <- array(c(0.5,0,0.2),c(1,2))
VARX <- ARMA(A=AR, B=diag(1,2), C=C)
MA <- array(c(1, .2, 0, .1, 0, 0, 1, .3), c(2,2,2))
ARMA <- ARMA(A=AR, B=MA, C=NULL)
ARMAX <- ARMA(A=AR, B=MA, C=C)
```

balanceMittnik  

Balance a state space model

Description

Balance a state space model a la Mittnik.

Usage

```r
balanceMittnik(model, n=NULL)
SVDbalanceMittnik(M, m, n=NULL)
```

Arguments

- `model`  
  An TSmodel object.
- `M`  
  a matrix. See details in MittnikReduction.
- `m`  
  an integer indicating the number of input series in the model.
- `n`  
  see details

Details

balanceMittnik calculate a state space model balance a la Mittnik. n is intended primarily for producing a state space model from the markov parameters of an ARMA model, but if it is supplied with an SS model the result will be a model with state dimension n based on the n largest singular values of the svd of a Hankel matrix of markov parameters generated by the original model. If n is not supplied then the singular values are printed and the program prompts for n. balanceMittnik calls SVDbalanceMittnik

SVDbalanceMittnik calculates a nested-balanced state space model by svd a la Mittnik. If state dim n is supplied then svd criteria are not calculated and the given n is used. Otherwise, the singular values are printed and the program prompts for n. M is a matrix with p x (m+p) blocks giving the markov parameters, that is, the first row of the Hankel matrix. It can be generated from the model as in the function markovParms, or from the data, as in the function estSSMittnik. m is the dimension of input series, which is needed to decompose M. The output dimension p is taken from nrow(M).

See also MittnikReduction and references.
Value
A state space model in a TSestModel object.

References
See references for MitnikReduction.

See Also
estVARXls, estVARXar MitnikReduction

Examples
```r
data("eg1.DSE.data.diff", package="dse")
model <- toSS(TSmodel(estVARXls(eg1.DSE.data.diff)))
# this prints information about singular values and prompts with
# Enter the number of singular values to use for balanced model:
newmodel <- balanceMittnik(model)
# 18 might be a good choice in this example.
newmodel <- balanceMittnik(model, n=18)
```

---

**bestTSestModel**  Select Best Model

Description
Select the best model.

Usage
```r
bestTSestModel(models, sample.start=10, sample.end=NULL,
criterion='aic', verbose=TRUE)
```

Arguments
- `models` a list of TSestModels.
- `sample.start` the starting point to use for calculating information criteria.
- `sample.end` the end point to use for calculating information criteria.
- `criterion` Criterion to be used for model selection. see informationTestsCalculations. 'taic' would be a better default but this is not available for VAR and ARMA models.
- `verbose` if TRUE then additional information is printed.
checkBalance

Details

Information criteria are calculated and return the best model from ... according to criterion models should be a list of TSestModel's. models[[i]]$estimates$pred is not recalculated but a sub-sample identified by sample.start and sample.end is used and the likelihood is recalculated. If sample.end=NULL data is used to the end of the sample. taic might be a better default selection criteria but it is not available for ARMA models.

Value

A TSestModel

See Also

estBlackBox1, estBlackBox2, estBlackBox3, estBlackBox4, informationTestsCalculations

Examples

data("eg1.DSE.data.diff", package="dse")
models <- list(estVARXls(eg1.DSE.data.diff), estVARXar(eg1.DSE.data.diff))
z <- bestTSestModel(models)

Description

Calculate the difference between observability and reachability gramians.

Usage

checkBalance(model)
    ## S3 method for class 'SS'
checkBalance(model)
    ## S3 method for class 'ARMA'
checkBalance(model)
    ## S3 method for class 'TSestModel'
checkBalance(model)

Arguments

    model A TSmodel object.

Details

Balanced models should have equal observability and reachability gramians.
checkBalanceMittnik

Value

No value is returned.

Side Effects

Differences between the observability and reachability gramians are printed.

See Also

checkBalanceMittnik MittnikReduction

Examples

data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARXls(eg1.DSE.data.diff))
checkBalance(model)

checkBalanceMittnik  Check Balance of a TSmodel

Description

Calculate the difference between observability and reachability gramians of the model transformed to Mittnik's form.

Usage

checkBalanceMittnik(model)

## S3 method for class 'ARMA'
checkBalanceMittnik(model)  # S3 method for class 'SS'
checkBalanceMittnik(model)  # S3 method for class 'TSestModel'
checkBalanceMittnik(model)

Arguments

model  An object of class TSmodel.

Details

Balanced models should have equal observability and reachability gramians.

Value

No value is returned.
checkConsistentDimensions

Side Effects
Differences between the observability and reachability gramians are printed.

See Also
checkBalance MittnikReduction

Examples

```r
data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARXls(eg1.DSE.data.diff))
checkBalanceMittnik(model)
```

Description
Check that dimensions of a model and data agree.

Usage

```r
checkConsistentDimensions(obj1, obj2=NULL)
```

Arguments

- **obj1**: An object containing a TSmodel, TSdata, or TSestModel, depending on the method.
- **obj2**: Another object containing TSdata corresponding to the TSmodel in obj1, or a TSmodel corresponding to the TSdata in obj1.

Details
Check that dimensions of a model and data agree. If obj1 is a TSestModel then if obj2 is NULL, TSdata is taken from obj1.
checkResiduals

**Value**
logical

**Examples**

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
checkConsistentDimensions(model)

checkResiduals **Autocorrelations Diagnostics**

**Description**
Calculate autocorrelation diagnostics of a time series matrix or TSdata or residuals of a TSestModel

**Usage**

```r
checkResiduals(obj, ...)  
## Default S3 method:  
checkResiduals(obj, ac=TRUE, pac=TRUE, select=seq(nseries(obj)),  
drop=NULL, plot.=TRUE, graphs.per.page=5, verbose=FALSE, ...)  
## S3 method for class 'TSdata'  
checkResiduals(obj, ...)  
## S3 method for class 'TSestModel'  
checkResiduals(obj, ...)
```

**Arguments**

- **obj**
  An TSestModel or TSdata object.
- **ac**
  If TRUE the auto-correlation function is plotted.
- **pac**
  If TRUE the partial auto-correlation function is plotted.
- **select**
  Is used to indicate a subset of the residual series. By default all residuals are used.
- **drop**
  Is used to indicate a subset of the residual time periods to drop. All residuals are used with the default (NULL). Typically this can be used to get rid of bad initial conditions (eg. drop=seq(10)) or outliers.
- **plot.**
  If FALSE then plots are not produced.
- **graphs.per.page**
  Integer indicating number of graphs to place on a page.
- **verbose**
  If TRUE then the auto-correlations and partial auto-correlations are printed if they are calculated.
- **...**
  arguments passed to other methods.
Details

This is a generic function. The default method works for a time series matrix which is treated as if it were a matrix of residuals. However, in a Box-Jenkins type of analysis the matrix may be data which is being evaluated to determine a model. The method for a TSestModel evaluates the residuals calculated by subtracting the output data from the model predictions.

Value

A list with residual diagnostic information: residuals, mean, cov, acf= autocorrelations, pacf= partial autocorrelations.

Side Effects

Diagnostic information is printed and plotted if a device is available. Output graphics can be paused between pages by setting par(ask=TRUE).

See Also

informationTests, Portmanteau

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
checkResiduals(model)

c coef.TSmodel

Extract or set Model Parameters

Description

Set or extract coefficients (parameter values) of model objects.

Usage

## S3 method for class 'TSmodel'
coef(object, ...)
## S3 method for class 'TSestModel'
coef(object, ...)
coef(object) <- value

## Default S3 replacement method:
coef(object) <- value

Arguments

<table>
<thead>
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<th>description</th>
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<td>object</td>
<td>An object of class TSmodel or TSestModel.</td>
</tr>
<tr>
<td>value</td>
<td>value to be assigned to object.</td>
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<td>...</td>
<td>(further arguments, currently disregarded).</td>
</tr>
</tbody>
</table>
Value

A vector of parameter values.

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
coef(model)
coef(model) <- 0.1 + coef(model)

combine

Combine two objects.

Description

This is a generic method to combine two objects of the same class to make a single object of that class.

Usage

combine(e1, e2)
## Default S3 method:
combine(e1, e2)

Arguments

e1, e2 
TSdata objects.

Value

An object of the same class as the argument but containing both e1 and e2.

See Also

tbind, combine.TSdata, combine.forecastCov

Examples

data("eg1.DSE.data.diff", package="dse")
data("eg1.DSE.data", package="dse")
new.data.set <- combine(eg1.DSE.data.diff, eg1.DSE.data)
**combine.forecastCov**  

Combine 2 Forecast Cov Objects

**Description**

Combine 2 forecastCov type objects.

**Usage**

```r
## S3 method for class 'forecastCov'
combine(e1, e2)

## S3 method for class 'forecastCovEstimatorsWRTdata'
combine(e1, e2)

## S3 method for class 'forecastCovEstimatorsWRTtrue'
combine(e1, e2)
```

**Arguments**

- `e1, e2` Objects as returned by functions which calculate forecast covariances.

**Details**

Functions which calculate forecast covariances return lists. Usually multiple estimation techniques or models will be combined together when the object is first formed. However, it is sometimes useful to add results calculated later without re-doing the initial object.

**Value**

An object as returned by functions which calculate forecast covariances.

**See Also**

`combine, forecastCovEstimatorsWRTdata, forecastCovEstimatorsWRTtrue`  

**Examples**

```r
#z <- combine(obj1, obj2)
```
**combine.TSdata**  
*Combine series from two TSdata objects.*

**Description**

Combine series from two TSdata objects.

**Usage**

```r
## S3 method for class 'TSdata'
combine(e1, e2)
```

**Arguments**

- `e1, e2`  
  TSdata objects.

**Value**

An object of class TSdata which includes series from both e1 and e2.

**See Also**

`tbind`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")
data("eg1.DSE.data", package="dse")
new.data.set <- combine(eg1.DSE.data.diff, eg1.DSE.data)
```

---

**DSEflags**  
*Flags to Indicate Use of Compiled Code*

**Description**

Determines if compiled code should be used or not.

**Usage**

```r
.DSEflags(new)
```

**Arguments**

- `new`  
  A list which must have elements COMPILED and DUP.
Details

Setting flags with this function is primarily for debugging. It should not normally be needed by
users. If called with no arguments, .DSEflags() returns the current setting. Several dse functions
which call compiled fortran or C code will use the equivalent S/R version if the .DSEflags()$COMPILED
returns FALSE.

Side Effects

The flag setting affects whether compiled fortran or C code is called.

Examples

.DSEflags(list(COMPILED=TRUE))
.DSEflags()$COMPILED

DSEversion

Description

Print version information.

Usage

DSEversion()

Examples

DSEversion()

e1.DSE.data

Four Time Series used in Gilbert (1993)

Description

Data is for Canada. The series start in March 1961 (April 1961 for e1.DSE.data.diff) and end
in June 1991, giving 364 observations on each variable (363 for e1.DSE.data.diff).

The input series is 90-day interest rates (R90) in both e1.DSE.data and e1.DSE.data.diff.
The output series are M1, GDP lagged two months, and CPI. M1, GDP and CPI were all season-
ally adjusted data. These are not transformed in e1.DSE.data and are first difference of logs in
e1.DSE.data.diff.

GDP is lagged because it is not available on as timely a basis. (The data was used in an example
where the intent was to build a model for timely monitoring.)
The Statistics Canada series identifiers are B14017, B1627, I37026, and B820200.
The data for M1 (B1627) were taken prior to revisions made in December 1993.
The file e1.dat contains the same data as e1.DSE.data in a simple ASCII file.
usage

data(eg1.DSE.data)
data(eg1.DSE.data.diff)

format

The objects eg1.DSE.data and eg1.DSE.data.diff are TSdata objects. The file eg1.dat is an ASCII file with 5 columns, the first enumerating the observations, the second giving the input series, and the third to fifth giving the output series. The input series name is "R90" and the output series names are "M1", "GDPl2" and "CPI". GDPl2 is GDP lagged two months.

source

Statistics Canada, Bank of Canada.

references


see also

TSdata

description

Data is for Canada unless otherwise indicated. The series start in February 1974 and end in September 1993 (236 observations on each variable).

The input series is 90 day interest rates (R90) and the ten output variables are CPI, GDP, M1, long run interest rates (RL), the Toronto stock exchange 300 index (TSE300), employment, the Canada/US exchange rate (PFX), a commodity price index in US dollars, US industrial production, and US CPI.

R90, RL and TSE are differenced. All other variables are in terms of percent change.

R90 is the 3 month prime corporate paper rate. While it is not set directly by the Bank of Canada, Bank policy influences it directly and it is often thought of as a proxy "policy variable."

The Statistics Canada identifiers are B14017 (R90), P484549 (CPI), I37026 (GDP), B1627 (M1), B14013 (RL), B4237 (TSE300), D767608 (employment), B3400 (PFX).

M.BCPI (commodity price index) is published by the Bank of Canada. JQIND (US industrial production), and CUSA0 (US CPI) are DRI identifiers.

The data for M1 (B1627) were taken prior to revisions made in December 1993.
Usage

data(egJofF.1dec93.data)

Format

This data is a TSdata object. The input series name is "R90" and the output series names are "CPI", "GDP", "M1", "RL", "TSE300", "employment", "PFX", "commod.price index", "US ind.prod." and "US CPI"

Source

Statistics Canada, Bank of Canada, DRI.

References


See Also

TSdata

estBlackBox

Estimate a TSmodel

Description

Estimate a TSmodel.

Usage

estBlackBox(data,...)

Arguments

data Data in an object of class TSdata.

Details

The function makes a call to estBlackBox4, also called bft, which seems the most reliable of functions estBlackBox1, estBlackBox2, estBlackBox4. My research in this area is no longer active, but the actual routine called could change if better methods appear.

To reduce load on the CRAN check servers, the example below uses max.lag=3 rather than the default 12 used in Gilbert (1995).
Value

A state space model in an object of class TSestModel.

References


Examples

data("egJofF.1dec93.data", package="dse")
goodmodel <- estBlackBox(egJofF.1dec93.data, max.lag=3)

Description

Estimate a TSmodel.

Usage

estBlackBox1(data, estimation="estVARXls", reduction="MittnikReduction", criterion="taic", trend=FALSE, subtract.means=FALSE, verbose=TRUE, max.lag=6)

Arguments

data  
  Data in an object of class TSdata.
estimation  
  Initial estimation method to be used.
reduction  
  Reduction method to be used.
criterion  
  Criterion to be used for model selection. see informationTestsCalculations.
trend  
  logical indicating if a trend should be estimated.
subtract.means  
  logical indicating if the mean should be subtracted from data before estimation.
verbose  
  logical indicating if information should be printed during estimation.
max.lag  
  integer indicating the maximum number of lags to consider.

Value

A state space model in an object of class TSestModel.

Side Effects

If verbose is TRUE then estimation information is printed and checkResiduals is run, which gives plots of information about the residuals.
estBlackBox2

See Also

informationTestsCalculations

Examples

data("egJoff.1dec93.data", package="dse")
goodmodel <- estBlackBox1(egJoff.1dec93.data)


estBlackBox2  Estimate a TSmodel

Description

Estimate a TSmodel.

Usage

estBlackBox2(data, estimation='estVARXls',
    lag.weight=.9,
    reduction='MittnikReduction',
    criterion='taic',
    trend=FALSE,
    subtract.means=FALSE, re.add.means=TRUE,
    standardize=FALSE, verbose=TRUE, max.lag=12)

Arguments

data a TSdata object.
estimation a character string indicating the estimation method to use.
lag.weight weighting to apply to lagged observations.
reduction character string indicating reduction procedure to use.
criterion criterion to be used for model selection. see informationTestsCalculations.
trend if TRUE include a trend in the model.
subtract.means if TRUE the mean is subtracted from the data before estimation.
re.add.means if subtract.means is TRUE then if re.add.means is TRUE the estimated model is converted back to a model for data without the mean subtracted.
standardize if TRUE the data is transformed so that all variables have the same variance.
verbose if TRUE then additional information from the estimation and reduction procedures is printed.
max.lag The number of lags to include in the VAR estimation.

Details

A model is estimated and then a reduction procedure applied. The default estimation procedure is least squares estimation of a VAR model with lagged values weighted. This procedure is discussed in Gilbert (1995).
Value
A TSestModel.

References

See Also
estBlackBox1, estBlackBox3, estBlackBox4, informationTestsCalculations

Examples
```
data("eg1.DSE.data.diff", package="dse")
z <- estBlackBox2(eg1.DSE.data.diff)
```

---

estBlackBox3

**Estimate a TSmodel**

**Description**
Estimate a TSmodel.

**Usage**
```
estBlackBox3(data, estimation='estVARXls',
lag.weight=1.0,
reduction='MittnikReduction',
criterion='aic',
trend=FALSE,
subtract.means=FALSE, re.add.means=TRUE,
standardize=FALSE, verbose=TRUE, max.lag=12, sample.start=10)
```

**Arguments**
- **data** A TSdata object.
- **estimation** A character string indicating the estimation method to use.
- **lag.weight** Weighting to apply to lagged observations.
- **reduction** Character string indicating reduction procedure to use.
- **criterion** Criterion to be used for model selection. see informationTestsCalculations. `aic` might be a better default selection criteria but it is not available for ARMA models.
- **trend** If TRUE include a trend in the model.
- **subtract.means** If TRUE the mean is subtracted from the data before estimation.
re.add.means If subtract.means is TRUE then if re.add.means is T the estimated model is converted back to a model for data without the mean subtracted.
standardize If TRUE the data is transformed so that all variables have the same variance.
verbose If TRUE then additional information from the estimation and reduction procedures is printed.
max.lag The number of lags to include in the VAR estimation.
sample.start The starting point to use for calculating information criteria.

Details
VAR models are estimated for each lag up to the specified max.lag. From these the best is selected according to the specified criteria. The reduction procedure is then applied to this best model and the best reduced model selected. The default estimation procedure is least squares estimation of a VAR model.

Value
A TSestModel.

See Also
estBlackBox1, estBlackBox2, estBlackBox4, informationTestsCalculations

Examples
data("eg1.DSE.data.diff", package="dse")
z <- estBlackBox3(eg1.DSE.data.diff)

---
estBlackBox4 Estimate a TSmodel

Description
Estimate a TSmodel with Brute Force Technique.

Usage
estBlackBox4(data, estimation="estVARXls",
lag.weight=1.0, variable.weights=1,
reduction="MittnikReduction",
criterion="taic",
trend=FALSE, subtract.means=FALSE, re.add.means=TRUE,
standardize=FALSE, verbose=TRUE, max.lag=12, sample.start=10, warn=TRUE)
bft(data, ... )
Arguments

- **data**: A TSdata object.
- **estimation**: a character string indicating the estimation method to use.
- **lag.weight**: weighting to apply to lagged observations.
- **variable.weights**: weighting to apply to series if estimation method is estWtVariables.
- **reduction**: reduction procedure to use.
- **criterion**: criterion to be used for model selection. see informationTestsCalculations.
- **trend**: if TRUE include a trend in the model.
- **subtract.means**: if TRUE the mean is subtracted from the data before estimation.
- **re.add.means**: if subtract.means is TRUE then if re.add.means is T the estimated model is converted back to a model for data without the mean subtracted.
- **standardize**: if TRUE the data is transformed so that all variables have the same variance.
- **verbose**: if TRUE then additional information from the estimation and reduction procedures is printed.
- **max.lag**: VAR estimation is done for each lag up to max.lag.
- **sample.start**: the starting point to use for calculating information criteria in the final selection.
- **warn**: logical indicating if warning messages should be suppressed.
- **...**: arguments passed to estBlackBox4.

Details

For each lag up to max.lag a VAR model is estimated and then a reduction procedure applied to select the best reduced model. Finally the best of the best reduced models is selected. The default estimation procedure is least squares estimation of the VAR models. This procedure is described as the brute force technique (bft) in Gilbert (1995).

Value

A TSestModel.

References


See Also

estBlackBox1, estBlackBox2, estBlackBox3, informationTestsCalculations

Examples

```r
data("eg1.DSE.data.diff", package="dse")
z <- bft(eg1.DSE.data.diff)
```
estimateModels

Estimate Models

Description

Estimate models using given estimation method

Usage

estimateModels(data, estimation.sample = NULL, trend = FALSE, quiet = FALSE, estimation.methods = NULL)

is.estimatedModels(obj)

Arguments

data
An object of class TSdata.
estimation.methods
A named list with the names indicating the estimation method and the value associated with the name is a list of arguments for each the method indicated. Its value should be NULL if no args are needed.
estimation.sample
An integer indicating the number of points in the sample to use for estimation. If it is NULL the whole sample is used.
trend
If trend is TRUE then a linear trend is calculated and returned as the element trend.coef.
quiet
If quiet is TRUE then most printing and some warning messages are suppressed.
obj
An object.

Details

Estimate models from data with estimation methods indicated by estimation.methods. This is primarily a utility for other functions.

Value

Element multi.model in the result is a list of the same length as estimation.methods with resulting models as elements.

See Also

EstEval, outOfSample.forecastCovEstimatorsWRTdata

Examples

data("eg1.DSE.data.diff", package="dse")
z <- estimateModels(eg1.DSE.data.diff, estimation.methods= list(bft=list(verbose=FALSE), estVARXar=list(max.lag=3)))
estimatorsHorizonForecastsWRTdata

Estimate models and forecast at given horizons

Description

Estimate models and forecast at given horizons.

Usage

estimatorsHorizonForecastsWRTdata(data,
estimation.sample=.5, horizons=1:12, quiet=FALSE,
estimation.methods=NULL)

Arguments

data A TSdata object.
estimation.methods A list of estimation methods to use. (See estimateModels.)
estimation.sample The portion of the sample to use for estimation.
horizons The horizons for which forecasts are to be produced.
quiet If true no estimation information is printed.

Details

estimation.sample indicates the part of the data to use for estimation. If estimation.sample is less than or equal 1.0 it is used to indicate the portion of points to use for estimation. Otherwise it should be an integer and is used to indicate the number of points from the beginning of the sample to use for estimation.

Value

A list of forecasts at different horizons as returned by horizonForecasts.

See Also

estimateModels, horizonForecasts

Examples

data("eg1.DSE.data.diff", package="dse")
z <- estimatorsHorizonForecastsWRTdata(eg1.DSE.data.diff,
estimation.methods=list(estVARXls=list(max.lag=3),
estVARXar=list(max.lag=3)))
estMaxLik

**Maximum Likelihood Estimation**

Description

Maximum likelihood estimation.

Usage

```r
estMaxLik(obj1, obj2=NULL, ...)  
## S3 method for class 'TSmodel'
estMaxLik(obj1, obj2, algorithm="optim",  
algorithm.args=list(method="BFGS", upper=Inf, lower=-Inf, hessian=TRUE),  
...)  
## S3 method for class 'TSestModel'
estMaxLik(obj1, obj2=TSdata(obj1), ...)  
## S3 method for class 'TSdata'
estMaxLik(obj1, obj2, ...)  
```

Arguments

- `obj1` - an object of class TSmodel, TSdata or TSestModel
- `obj2` - TSdata or a TSmodel to be fitted with obj1.
- `algorithm` - the algorithm ('optim', or 'nlm') to use for maximization.
- `algorithm.args` - arguments for the optimization algorithm.
- `...` - arguments passed on to other methods.

Details

One of `obj1` or `obj2` should specify a TSmodel and the other TSdata. If `obj1` is a TSestModel and `obj2` is NULL, then the data is extracted from `obj1`. The TSmodel object is used to specify both the initial parameter values and the model structure (the placement of the parameters in the various arrays of the TSmodel). Estimation attempts to minimize the negative log likelihood (as returned by `l`) of the given model structure by adjusting the parameter values. A TSmodel can also have constant values in some array elements, and these are not changed. (See SS, ARMA and fixConstants regarding setting of constants.)

With the number of parameter typically used in multivariate time series models, the default maximum number of iterations may not be enough. Be sure to check for convergence (a warning is printed at the end, or use `summary` on the result). The maximum iterations is passed to the estimation algorithm with `algorithm.args`, but the elements of that list will depend on the specified optimization algorithm (so see the help for the algorithm). The example below is for the default `optim` algorithm.
Value

The value returned is an object of class TSestModel with additional elements est$converged, which is TRUE or FALSE indicating convergence, est$convergeCode, which is the code returned by the estimation algorithm, and est$results, which are detailed results returned by the estimation algorithm. The hessian and gradient in results could potentially be used for restarting in the case of non-convergence, but that has not yet been implemented.

Warning

Maximum likelihood estimation of multivariate time series models tends to be problematic, even when a good structure and good starting parameter values are known. This is especially true for state space models. Also, it seems that in-sample fit is often obtained at the expense of out-of-sample forecasting ability. If a prior model structure is not important then the bft estimation method may be preferable.

See Also

optim, nlm, estVARXls, bft, TSmodel, l, SS, ARMA, fixConstants

Examples

true.model <- ARMA(A=c(1, 0.5), B=1)
est.model <- estMaxLik(true.model, simulate(true.model))summary(est.model)est.modeltfplot(est.model)est.model <- estMaxLik(true.model, simulate(true.model),algorithm.args=list(method="BFGS", upper=Inf, lower=-Inf, hessian=TRUE,control=list(maxit=10000)))

estSSfromVARX

Estimate a state space TSmodel using VAR estimation

Description

Estimate a VAR TSmodel with (optionally) an exogenous input and convert to state space.

Usage

estSSfromVARX(data, warn=TRUE, ...)

Arguments

data An object with the structure of an object of class TSdata (see TSdata).
warn Logical indicating if warnings should be printed (TRUE) or suppressed (FALSE).
... See arguments to estVARXls
estSSMittnik

Details

This function uses the functions estVARXls and toSS.

Value

A state space model in an object of class TSestModel.

References


See Also

toSS estSSMittnik bft estVARXls estMaxLik

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estSSfromVARX(eg1.DSE.data.diff)

---

estSSMittnik  Estimate a State Space Model

Description

Estimate a state space model using Mittnik's markov parameter estimation.

Usage

estSSMittnik(data, max.lag=6, n=NULL, subtract.means=FALSE, normalize=FALSE)

Arguments

data A TSdata object.
max.lag The number of markov parameters to estimate.
n The state dimension.
subtract.means If TRUE subtract the means from the data before estimation.
normalize If TRUE normalize the data before estimation.
Details

Estimate a nested-balanced state space model by svd from least squares estimate of markov parameters a la Mittnik (1989, p1195). The quality of the estimate seems to be quite sensitive to max.lag, and this is not properly resolved yet. If n is not supplied the svd criteria will be printed and n prompted for. If subtract.means=T then the sample mean is subtracted. If normalize is T the lsfit estimation is done with outputs normalize to cov=I (There still seems to be something wrong here!!). The model is then re-transformed to the original scale.

See MittnikReduction and references cited there. If the state dimension is not specified then the singular values of the Hankel matrix are printed and the user is prompted for the state dimension.

Value

A state space model in an object of class TSestModel.

References

See references for MittnikReduction.

See Also

MittnikReduction estVARXls bft

Examples

data("egJofF.1dec93.data", package="dse")
# this prints information about singular values and prompts with
#Enter the number of singular values to use for balanced model:
model <- estSSMittnik(egJofF.1dec93.data)
# the choice is difficult in this example.
model <- estSSMittnik(egJofF.1dec93.data, n=3)
estVARXar

Arguments

data A TSdata object.
subtract.means If TRUE subtract the means from the data before estimation.
re.add.means If TRUE the model is adjusted for the non-zero mean data when returned. If subtract.means is also TRUE then the mean is added back to the data.
standardize Note that the mean is not subtracted unless subtract.means is TRUE. A VAR model in an object of class TSestModel.
unstandardize If TRUE and standardize is TRUE then the returned model is adjusted to correspond to the original data.
aic Passed to function ar.
max.lag The maximum number of lags that should be considered.
method Passed to function ar.
warn If TRUE certain warning message are suppressed.

Details

This function estimates a VAR model with exogenous variable using ar(). Residuals, etc, are calculated by evaluating the estimated model with ARMA. The procedure ar is used by combine exogenous variables and endogenous variable and estimating as if all variables were endogenous. The estVARXar method does not support trend estimation (as in estVARXIs).

If aic=TRUE the number of lags is determined by an AIC statistic (see ar). If an exogenous (input) variable is supplied the input and output are combined (i.e. both treated as outputs) for estimation, and the resulting model is converted back by transposing the exogenous variable part of the polynomial and discarding inappropriate blocks. Residuals, etc, are calculated by evaluating the estimated model as a TSmodel/ARMA with the data (i.e. residuals are not the residuals from the regression).

Note: ar uses a Yule-Walker approach (uses autocorrelations) so effectively the model is for data with means removed. Thus subtract.means does not make much difference and re.add.means must be TRUE to get back to a model for the original data.

The convention for AR(0) and sign are changed to ARMA format. Data should be of class TSdata. The exog. variable is shifted so contemporaneous effects enter. the model for the exog. variable (as estimated by ar() is discarded.

Value

A TSestModel object containing an ARMA TSmodel object. The model has no MA portion so it is a VAR model.

References


See Also

estSSfromVARX estSSMittnik bft estVARXls estMaxLik ar DSE.ar

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXar(eg1.DSE.data.diff)

estVARXls

Estimate a VAR TSmodel

Description

Estimate a VAR TSmodel with (optionally) an exogenous input and (optionally) a trend.

Usage

estVARXls(data, subtract.means=FALSE, re.add.means=TRUE, standardize=FALSE,
unstandardize=TRUE, max.lag=NULL, trend=FALSE, lag.weight=1.0, warn=TRUE)

Arguments

data A TSdata object.
subtract.means If TRUE subtract the means from the data before estimation.
re.add.means If TRUE and subtract.means is TRUE then the mean is added back to the data
and the model is adjusted for the non-zero mean data when returned.
standardize If TRUE divide each series by its sample standard deviation before estimation.
Note that the mean is not subtracted unless subtract.means is TRUE.
unstandardize If TRUE and standardize is TRUE then the returned model is adjusted to corre-
spond to the original data.
trend If TRUE a trend is estimated.
max.lag Number of lags to be used.
lag.weight Weight between 0 and 1 to be applied to lagged data. Lower weights mean
lagged data is less important (more noisy).
warn If TRUE a warning message is issued when missing data (NA) is detected and
the model predictions are reconstructed from the lsfit residuals.

Details

A VAR model is fitted by least squares regression using lsfit. The argument max.lag determines the
number of lags. If it is not specified then six lags are used. This is an exceedingly naive approach,
so the max.lag argument really should be specified (or see bft for a more complete approach to
model selection.) If a trend is not estimated the function estVARXar may be preferred. Missing
data is allowed in lsfit, but not (yet) by ARMA which generates the model predictions, etc., based
on the estimated model and the data. (This is done to ensure the result is consistent with other
estWtVariables

estimation techniques.) In the case of missing data ARMA is not used and the model predictions, etc., are generated by adding the data and the lsfit residual. This is slightly different from using ARMA, especially with respect to initial conditions.

Value

A TSestModel object containing a TSmodel object which is a VAR model.

References


See Also

estSSfromVARX estSSMittnik bft estVARXar estMaxLik

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)

estWtVariables  Weighted Estimation

Description

estWtVariables

Usage

estWtVariables(data, variable.weights, estimation="estVARXls", estimation.args=NULL)

Arguments

data A TSdata object.
variable.weights weights to use for each output series.
estimation An estimation method.
estimation.args An arguments for the estimation method.
Details
Weight series so that some series residuals are more important than others. Each output variable is scaled according to variable.weights, estimate is done, and then the estimated model unscaled. Estimation is done the method specified by estimate and any arguments specified by estimation.args. estimation.args should be NULL if no args are needed.

Value
A TSestModel.

See Also
estVARXls estBlackBox bft estMaxLik

excludeForecastCov
Filter Object to Remove Forecasts

Description
Filter object to remove forecasts.

Usage
excludeForecastCov(obj, exclude.series=NULL)

Arguments
  obj                An object as returned by stripMine.
  exclude.series    An indication of series to which should be excluded.

Details
Exclude results which depend on the indicated series from a (forecastCovEstimatorsWRTdata.subsets forecastCov) object.

Value
The returned result is a forecastCov object like obj, but filtered to remove any forecasts from models which depend on the series which are indicated for exclusion.

See Also
minForecastCov, selectForecastCov
Examples

data("eg1.DSE.data.diff", package="dse")
z <- stripMine(eg1.DSE.data.diff, essential.data=c(1,2),
estimation.methods=list(estVARXls=list(max.lag=3)))
z <- excludeForecastCov(z, exclude.series=3)

extractforecastCov  Extract Forecast Covariance

Description

extract forecastCov from objects

Usage

extractforecastCov(e, n)
## S3 method for class 'forecastCovEstimatorsWRTdata'
extractforecastCov(e, n)
## S3 method for class 'forecastCovEstimatorsFromModel'
extractforecastCov(e, n)

Arguments

e A "forecastCovEstimatorsWRTdata", "forecastCov" object.
n A vector on integers.

Details

Select a subset of models and their forecast covariances from a larger object.

Value

A forecastCov object.

See Also

forecastCov
featherForecasts  

Multiple Horizon-Step Ahead Forecasts

Description

Calculate multiple horizon-step ahead forecasts.

Usage

```
featherForecasts(obj, ...)  
## S3 method for class 'TSestModel'
featherForecasts(obj, data=NULL, ...)
## S3 method for class 'TSdata'
featherForecasts(obj, model, ...)
## S3 method for class 'TSmodel'
featherForecasts(obj, data, horizon=36,  
from.periods =NULL, ...)
  is.featherForecasts(obj)
```

Arguments

- `obj` : an object of class TSmodel.
- `data` : an object of class TSdata.
- `model` : an object of class TSmodel.
- `from.periods` : the starting points to use for forecasts.
- `horizon` : the number of periods to forecast.
- `...` : for a TSmodel additional arguments are passed to `l()`

Details

Calculate multiple horizon-step ahead forecasts ie. use the samples indicated by `from.periods` to calculate forecasts for horizon periods. Thus, for example, the result of `featherForecasts(model, data, from.periods=c(200,250,300))` would be forecasts for 1 through 36 steps ahead (the default), starting at the 200th, 250th, and 300th point of `outputData(data)`. This function assumes that `inputData(data)` (the exogenous variable) is as long as necessary for the most future forecast.

Value

The result is a list of class featherForecasts with elements `model` (a TSestModel), `data`, `from.periods`, `featherForecasts`. The element `featherForecasts` is a list with length(`from.periods`) elements, each of which is a tframed matrix. There is a plot method for this class.

See Also

`forecast`, `horizonForecasts`
Examples

data("egJofF.1dec93.data", package="dse")
model <- estVARXls(egJofF.1dec93.data)
pr <- featherForecasts(model, egJofF.1dec93.data)
tfplot(pr)

fixConstants

Description

Fix specified coefficients to constant values or any coefficients within fuzz of 0.0 or 1.0 to exactly 0.0 or 1.0. This will not change the model much but will affect some estimation techniques and information criteria results, as these are considered to be constants rather than coefficients.

Usage

fixConstants(model, fuzz=1e-5, constants=NULL)

Arguments

model an object of class TSmodel.
fuzz absolute difference to be considered equivalent.
constants NULL or a list of logical arrays.

Details

If constants is not NULL then parameters within fuzz of 0.0 or 1.0 are set as constants 0.0 or 1.0. If constants is not NULL then it should be a list with logical arrays named F, G ..., with TRUE corresponding to any array elements which are to be treated as constant.

Value

An object of class 'SS' 'TSmodel' with some array entries set to constants 0.0 or 1.0.

See Also

fixF

Examples

f <- array(c(.5,.3,.2,.4),c(2,2))
h <- array(c(1,0,0,1),c(2,2))
k <- array(c(.5,.3,.2,.4),c(2,2))
ss <- SS(F=f,G=NULL,H=h,K=k)
ss
coef(ss)
ss <- fixConstants(ss, constants=list(
\[ F = \text{matrix}(\text{c}(\text{TRUE}, \text{FALSE}, \text{FALSE}, \text{FALSE}), 2, 2)) \]

\[ \text{ss} \]
\[ \text{coef(ss)} \]
\[ \text{data("eg1.DSE.data.diff", package="dse")} \]
\[ \text{model} \leftarrow \text{toARMA(toSS(estVARXls(eg1.DSE.data.diff)))} \]
\[ \text{model} \leftarrow \text{fixConstants(model)} \]

---

**fixF**  
*Set SS Model F Matrix to Constants*

**Description**

Set any parameters of the F matrix to constants. The same values are retained but they are considered to be constants rather than parameters. This will not change the model but will affect some estimation techniques and information criteria results.

**Usage**

\[ \text{fixF(model)} \]

**Arguments**

- `model`  
  An object of class TSmodel.

**Value**

An SS TSmodel object.

**See Also**

- `fixConstants`

**Examples**

\[ \text{data("eg1.DSE.data.diff", package="dse")} \]
\[ \text{model} \leftarrow \text{toSS(estVARXls(eg1.DSE.data.diff))} \]
\[ \text{model} \leftarrow \text{fixF(model)} \]
Forecast Multiple Steps Ahead

Description

Calculate forecasts multiple steps ahead.

Usage

```r
is.forecast(obj)
forecast(obj, ...)
## S3 method for class 'TSmodel'
forecast(obj, data, horizon=36,
         conditioning.inputs=NULL,
         conditioning.inputs.forecasts=NULL, percent=NULL, ...)
## S3 method for class 'TSEstModel'
forecast(obj, ...)
## S3 method for class 'TSdata'
forecast(obj, model, ...)
```

Arguments

- `obj`: An object of a class for which a specific method is available.
- `model`: An object of class `TSmodel`.
- `data`: An object of class `TSdata`.
- `conditioning.inputs`: A time series matrix or list of time series matrices to use as input variables.
- `conditioning.inputs.forecasts`: A time series matrix or list of time series matrices to append to input variables for the forecast periods.
- `horizon`: The number of periods to forecast.
- `percent`: A vector indicating percentages of the last input to use for forecast periods.
- `...`: Arguments passed to `l()`.

Details

Calculate (multiple) forecasts from the end of data to a horizon determined either from supplied input data or the argument horizon (more details below). In the case of a model with no inputs the horizon is determined by the argument horizon. In the case of models with inputs, on which the forecasts are conditioned, the argument horizon is ignored (except when percent is specified) and the actual horizon is determined by the inputs in the following way: If inputs are not specified by optional arguments (as below) then the default will be to use `inputData(data)`. This will be the same as the function `l()` unless `inputData(data)` is longer than `outputData(data)` (after NAs are trimmed from each separately). Otherwise, if `conditioning.inputs` is specified it is used for `inputData(data)`. It must be a time series matrix or a list of time series matrices each of which is used...
Forecast covariance for different models

## Description

Calculate the forecast covariance for different models.

## Usage

```r
is.forecastCov(obj)
forecastCov(obj, ... , data=NULL, horizons=1:12, discard.before=NULL, 
zero=FALSE, trend=FALSE, estimation.sample= NULL, 
compiled=.DSEflags()$COMPiled)
## S3 method for class 'TSmodel'
forecastCov(obj, ... , data=NULL, 
horizons=1:12, discard.before=NULL, 
zero=FALSE, trend=FALSE, estimation.sample= Tobs(data), 
compiled=.DSEflags()$COMPiled)
## S3 method for class 'TSestModel'
```

### Value

The result is an object of class forecast which is a list with elements model, horizon, conditioning.inputs, percent, pred and forecast. The element forecast is a list with TSdata objects as elements, one for each element in the list conditioning.inputs. The element pred contains the one-step ahead forecasts for the periods when output data is available. There is a plot method for this class.

### See Also

`featherForecasts`, `horizonForecasts`

### Examples

```r
data("egJofF.1dec93.data", package="dse")
model <- estVARXls(window(egJofF.1dec93.data, end=c(1985,12)))
pr <- forecast(model, conditioning.inputs=inputData(egJofF.1dec93.data))
#tfplot(pr) Rbug 0.90.1
is.forecast(pr)
```
forecastCov(obj, ..., data=TSdata(obj),
    horizons=1:12, discard.before=NULL, zero=FALSE, trend=FALSE,
    estimation.sample= Tobs(TSdata(obj)), compiled=.DSEflags()$COMPILED)
## S3 method for class 'TSdata'
forecastCov(obj, ..., data=NULL,
    horizons=1:12, discard.before=1,
    zero=FALSE, trend=FALSE, estimation.sample= NULL,
    compiled=.DSEflags()$COMPILED)

Arguments

obj TSData or one or more TSModes or TSestModels
data an object of class TSData.
discard.before period before which forecasts should be discarded when calculating covariance.
horizons horizons for which forecast covariance should be calculated.
zero if TRUE the covariance is calculated for a forecast of zero.
trend if TRUE the covariance is calculated for a forecast of trend.
estimation.sample portion of the sample to use for calculating the trend.
compiled a logical indicating if compiled code should be used. (Usually true except for debugging.)
... arguments passed to other methods.

Details

Calculate the forecast cov of obj relative to data. If obj is TSData then the output data is used as the forecast. For other classes of obj TSMode(obj) is used with data to produce a forecast. TSMode() is also applied to each element of ... to extract a model. All models should work with data. If obj is a TSestModel and data is NULL then TSData(obj) is used as the data. This is multiple applications of forecastCovSingleModel discard.before is an integer indicating the number of points in the beginning of forecasts to discard before calculating covariances. If it is the default, NULL, then the default (minimumStartupLag) will be used for each model and the default (1) will be used for trend and zero. If zero is TRUE then forecastCov is also calculated for a forecast of zero. If trend is TRUE then forecastCov is also calculated for a forecast of a linear trend using data to estimation.sample.

Value

A list with the forecast covariance for supplied models on the given sample. This is in the element forecastCov of the result. Other elements contain information in the arguments.

Examples

data("eg1.DSE.data.diff", package="dse")
model1 <- estVARXar(eg1.DSE.data.diff)
model2 <- estVARXls(eg1.DSE.data.diff)
z <- forecastCov(model1, model2, data=trimNA(eg1.DSE.data.diff))
is.forecastCov(z)
forecastCovEstimatorsWRTdata

Calculate Forecast Cov of Estimators WRT Data

Description

forecast covariance of estimated models with respect to a given sample

Usage

forecastCovEstimatorsWRTdata(data, estimation.sample=NULL, compiled=.DSEflags()$COMPiled, discard.before=10, horizons=1:12, zero=FALSE, trend=FALSE, quiet=FALSE, estimation.methods=NULL)

is.forecastCovEstimatorsWRTdata(obj)

Arguments

data an object of class TSdata.
estimation.methods a list as used by estimateModels.
discard.before an integer indicating the number of points in the beginning of forecasts to discard for calculating covariances.
zero if TRUE then forecastCov is also calculated for a forecast of zero.
trend if TRUE then forecastCov is also calculated for a forecast of a linear trend.
estimation.sample an integer indicating the number of points in the sample to use for estimation. If it is NULL the whole sample is used.
horizons horizons for which forecast covariance should be calculated.
quiet if TRUE then estimation information is not printed.
compiled a logical indicating if the compiled version of the code should be used. (FALSE would typically only be used for debugging.)
obj an object.

Details

Calculate the forecasts cov of models estimated from data with estimation methods indicated by estimation.methods (see estimateModels). estimation.sample is an integer indicating the number of points in the sample to use for estimation. If it is NULL the whole sample is used.

Value

A list with the forecast covariance for supplied models on the given sample. This is in the element forecastCov of the result. Other elements contain information in the arguments.
See Also

outOfSample.forecastCovEstimatorsWRTdata, estimateModels

Examples

data("eg1.DSE.data.diff", package="dse")
z <- forecastCovEstimatorsWRTdata(eg1.DSE.data.diff,
estimation.methods=list(estVARXls=list(max.lag=4)))

forecastCovEstimatorsWRTtrue

Compare Forecasts Cov Relative to True Model Output

Description

Compare covariance of the forecasts less the true model output

Usage

forecastCovEstimatorsWRTtrue(true.model, rng=NULL,
simulation.args=NULL,
est.replications = 2, pred.replications = 2,
discard.before = 10, horizons = 1:12, quiet =FALSE,
estimation.methods=NULL, compiled=.DSEflags()$COMPILED)

is.forecastCovEstimatorsWRTtrue(obj)

Arguments

ttrue.model An object of class TSmodel.
estimation.methods A list as used by estimateModels.
simulation.args an arguments to be passed to simulate.
est.replications An arguments to be passed to simulate.
pred.replications An arguments to be passed to simulate.
discard.before An integer indicating the number of points in the beginning of forecasts to discard for calculating covariances.
horizons Horizons for which forecast covariance should be calculated.
rng If specified then it is used to set RNG.
quiet If TRUE then some messages are not printed.
compiled a logical indicating if the compiled version of the code should be used. (FALSE would typically only be used for debugging.)
obj an object.
Details

Calculate the forecasts cov of models estimated from simulations of true.model with estimation methods indicated by estimation.methods (see estimateModels). This function makes multiple calls to forecastCovWRTtrue.

Value

The returned results has element forecastCov.true, forecastCov.zero, forecastCov.trend containing covariances averaged over estimation replications and simulation replications (forecasts will not change but simulated data will). forecastCov a list of the same length as estimation.methods with each element containing covariances averaged over estimation replications and simulation replications. estimatedModels a list of length est.replications, with each elements as returned by estimateModels, thus each element has multi.model as a subelement containing models for different estimation techniques. So, eg. estimatedModels[[2]]$multi.model[[1]] in the result will be the model from the first estimation technique in the second replication.

See Also

forecastCovWRTtrue forecastCovEstimatorsWRTdata

Examples

data("eg1.DSE.data.diff", package="dse")
true.model <- estVARXls(eg1.DSE.data.diff) # just to have a starting model
z <- forecastCovEstimatorsWRTtrue(true.model,
estimation.methods=list(estVARXls=list(max.lag=4)))
Arguments

- **true.model**: An object of class TSmodel or TSestModel.
- **discard.before**: An integer indicating the number of points in the beginning of forecasts to discard for calculating covariances.
- **est.replications**: An integer indicating the number of times simulation and estimation are repeated.
- **pred.replications**: An argument passed to `forecastCovWRTtrue`.
- **simulation.args**: A list of any arguments which should be passed to simulate in order to simulate the true model.
- **horizons**: Horizons for which forecast covariance should be calculated.
- **rng**: If specified then it is used to set RNG.
- **quiet**: If TRUE then some messages are not printed.
- **estimation.methods**: A list as used by `estimateModels`.
- **criteria**: A list of any arguments which should be passed to simulate in order to simulate the true model.
- **compiled**: A logical indicating if compiled code should be used. (Usually true except for debugging.)

Details

Calculate the forecasts cov of reduced models estimated from simulations of true.model with an estimation method indicated by estimation.methods. (estimation.methods is as in estimation.models BUT ONLY THE FIRST IS USED.) discard.before is an integer indicating 1+the number of points in the beginning of forecasts to discard for calculating forecast covariances. criteria can be a vector of criteria as in `informationTests`, (eg c("taic", "tbic") in which case the "best" model for each criteria is accounted separately. (ie. it is added to the beginning of the list of estimated models)

Value

A list ...

forecastCovWRTtrue  Compare Forecasts to True Model Output

Description

Generate forecasts and compare them against the output of a true model.
Usage

testCovWRTtrue(models, true.model,
    pred.replications=1, simulation.args=NULL, quiet=FALSE, rng=NULL,
    compiled=.DSEflags()$COMPILED,
    horizons=1:12, discard.before=10, trend=NULL, zero=NULL)

is.testCovWRTdata(obj)

Arguments

models        A list of objects of class TSmodel.
true.model    An object of class TSmodel or TSestModel.
discard.before An integer indicating the number of points in the beginning of forecasts to discard for calculating covariances.
zero          If TRUE then forecastCov is also calculated for a forecast of zero.
trend         If TRUE then forecastCov is also calculated for a forecast of a linear trend.
pred.replications integer indicating the number of times simulated data is generated.
simulation.args A list of any arguments which should be passed to simulate in order to simulate the true model.
horizons      Horizons for which forecast covariance should be calculated.
rng           If specified then it is used to set RNG.
quiet         If TRUE then some messages are not printed.
compiled      a logical indicating if compiled code should be used. (Usually true except for debugging.)
obj           an object.

Details

The true model is used to generate data and for each generated data set the forecasts of the models are evaluated against the simulated data. If trend is not null it is treated as a model output (forecast) and should be the same dimension as a simulation of the models with simulation.args. If zero is not null a zero forecast is also evaluated. If simulating the true model requires input data then a convenient way to do this is for true.model to be a TSestModel. Otherwise, input data should be passed in simulation.args

Value

A list with the forecast covariance for supplied models on samples generated by the given true model. This is in the element forecastCov of the result. Other elements contain information in the arguments.

See Also

forecastCovEstimatorsWRTdata simulate EstEval distribution MonteCarloSimulations
Examples

```r
# A starting model
true.model <- estVARXls(eg1.DSE.data.diff)
data <- simulate(true.model)
models <- list(TSmodel(estVARXar(data)), TSmodel(estVARXls(data)))
z <- forecastCovWRTtrue(models, true.model)
```

Description

Extract forecasts from and object.

Usage

```r
forecasts(obj)
## S3 method for class 'forecast'
forecasts(obj)
## S3 method for class 'featherForecasts'
forecasts(obj)
## S3 method for class 'horizonForecasts'
forecasts(obj)
```

Arguments

- **obj**: An object which contains forecasts.

Details

This generic method extracts the forecasts (only) from objects returned by other methods that calculate forecasts. Usually the objects returned by the methods which calculate forecasts contain additional information which is not returned by this extractor.

Value

The forecasts from an object which contains forecasts.

See Also

- `forecast`

Examples

```r
# A starting model
true.model <- estVARXls(eg1.DSE.data.diff)
data <- simulate(true.model)
models <- list(TSmodel(estVARXar(data)), TSmodel(estVARXls(data)))
z <- forecastCovWRTtrue(models, true.model)
```
gmap

Basis Transformation of a Model.

Description
Transform the basis for the state by a given invertible matrix.

Usage

gmap(g, model)

Arguments

  g     An invertible matrix
  model An object of class TSmodel.

Details
If the input model is in state space form g is a change of basis for the state. If the input model is in
ARMA form then the polynomials are premultiplied by g. If g is a scalar it is treated as a diagonal
matrix.

Value
An equivalent model transformed using g.

Examples

data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARXls(eg1.DSE.data.diff))
gmap(2, model)

horizonForecasts

Calculate forecasts at specified horizons

Description
Calculate forecasts at specified horizons.
Usage

is.horizonForecasts(obj)
horizonForecasts(obj, ...)

## S3 method for class 'TSmodel'
horizonForecasts(obj, data, horizons=1:4, discard.before=minimumStartupLag(obj), compiled=.DSEflags()$COMPILED, ...)

## S3 method for class 'TSestModel'
horizonForecasts(obj, data=NULL, ...)

## S3 method for class 'TSdata'
horizonForecasts(obj, model, ...)

## S3 method for class 'forecastCov'
horizonForecasts(obj,horizons=NULL, discard.before=NULL, ...)

Arguments

obj an object of class TSmodel, TSdata, or TSestModel.
model an object of class TSmodel.
data an object of class TSdata
horizons a vector of integers indicating the horizon at which forecasts should be produced.
discard.before period before which forecasts are not calculated.
compiled if TRUE compiled code is called.
... arguments passed to other methods.

Details

Calculate multiple 'horizon'-step ahead forecasts ie. calculate forecasts but return only those indicated by horizons. Thus, for example, the result of horizonForecasts(model, data horizons=c(1,5)) would be the one-step ahead and five step ahead forecasts.

Value

The result is a list of class horizonForecasts with elements model (a TSmodel), data, horizons, discard.before, and horizonForecasts. horizonForecasts is an array with three dimension: c(length(horizons), dim(model$data)). Projections are not calculated before discard.before or after the end of outputData(data). Each horizon is aligned so that horizonForecasts[h,t] contains the forecast for the data point outputData(data)[t] (from horizon[h] periods prior).

See Also

featherForecasts

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
z <- horizonForecasts(model, eg1.DSE.data.diff)
horizonForecastsCompiled

*Calculate forecasts at specified horizons*

**Description**

Calculate forecasts at specified horizons.

**Usage**

```r
horizonForecastsCompiled(obj, data, horizons=1:4,
discard.before=minimumStartupLag(obj))
## S3 method for class 'SS'
horizonForecastsCompiled(obj, data, horizons=1:4,
discard.before=minimumStartupLag(obj))
## S3 method for class 'ARMA'
horizonForecastsCompiled(obj, data, horizons=1:4,
discard.before=minimumStartupLag(obj))
```

**Arguments**

- `obj` see `horizonForecasts`
- `data` see `horizonForecasts`
- `horizons` see `horizonForecasts`
- `discard.before` see `horizonForecasts`

**Details**

Internal function not to be called by users. See `horizonForecasts`.

**Value**

See `horizonForecasts`.

**See Also**

`horizonForecasts`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
z <- horizonForecasts(model, eg1.DSE.data.diff)
```
informationTests

Tabulates selection criteria

Description

Tabulates several model selection criteria.

Usage

informationTests(..., sample.start=1, sample.end=NULL, Print=TRUE, warn=TRUE)

Arguments

... At least one object of class TSestModel.
sample.start The start of the period to use for criteria calculations.
sample.end The end of the period to use for criteria calculations. If omitted the end of the sample is used.
Print If FALSE then printing suppressed.
warn If FALSE then some warning messages are suppressed.

Value

A matrix of the value for each model on each test returned invisibly.

Side Effects

Criteria are tabulated for all models in the list.

See Also

informationTestsCalculations

Examples

data("eg1.DSE.data.diff", package="dse")
model1 <- estVARXls(eg1.DSE.data.diff)
model2 <- estVARXar(eg1.DSE.data.diff)
informationTests(model1, model2)
informationTestsCalculations

*Calculate selection criteria*

**Description**

Calculates several model selection criteria.

**Usage**

```r
informationTestsCalculations(lst, sample.start=1, sample.end=NULL, warn=TRUE)
```

**Arguments**

- `lst`: One or more objects of class TESestModel.
- `sample.start`: The start of the period to use for criteria calculations.
- `sample.end`: The end of the period to use for criteria calculations. If omitted the end of the sample is used.
- `warn`: If FALSE then some warning messages are suppressed.

**Value**

The calculated values are returned in a vector with names: port, like, aic, bic, gvc, rice, fpe, taic, tbic, tgvc, trice and tfpe. These correspond to values for the Portmanteau test, likelihood, Akaike Information Criterion, Bayes Information Criterion, Generalized Cross Validation, Rice Criterion, and Final Prediction Error. The preceeding 't' indicates that the theoretical parameter space dimension has been used, rather than the number of coefficient (parameter) values. Methods which select a model based on some information criterion calculated by `informationTestsCalculations` should use the name of the vector element to specify the test value which is to be used.

**See Also**

`informationTests`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
informationTestsCalculations(model)
```
**inputData**

**TSdata Series**

**Description**

Extract or set input or output series in a TSdata object.

**Usage**

```r
inputData(x, series=seqN(nseriesInput(x)))
## Default S3 method:
inputData(x, series=seqN(nseriesInput(x)))
## S3 method for class 'TSdata'
inputData(x, series=seqN(nseriesInput(x)))
## S3 method for class 'TSestModel'
inputData(x, series=seqN(nseriesInput(x)))

outputData(x, series=seqN(nseriesOutput(x)))
## Default S3 method:
outputData(x, series=seqN(nseriesOutput(x)))
## S3 method for class 'TSdata'
outputData(x, series=seqN(nseriesOutput(x)))
## S3 method for class 'TSestModel'
outputData(x, series=seqN(nseriesOutput(x)))

inputData(x) <- value
outputData(x) <- value
```

**Arguments**

- **x**
  - object of class TSdata.
- **value**
  - a time series matrix.
- **series**
  - vector of strings or integers indicating the series to select.

**Value**

The first usages returns the input or output series. The second usages assigns the input or output series.

**See Also**

- `TSdata`
- `selectSeries`

**Examples**

```r
data("eg1.DSE.data", package="dse")
outputData(eg1.DSE.data)
```
is.forecastCovEstimatorsWRTdata.subsets

Check Inheritance

Description

Check inheritance.

Usage

is.forecastCovEstimatorsWRTdata.subsets(obj)

Arguments

obj Any object.

Details

This tests if an object inherits from forecastCovEstimatorsWRTdata.subsets. This type of object code be generated in different ways but the only current example is stripMine.

Value

logical

See Also

stripMine

Evaluate a TSmodel

Description

Evaluate a model with data.

Usage

l(obj1, obj2, ...)

## S3 method for class 'TSdata'
l(obj1, obj2, ...)

## S3 method for class 'TSestModel'
l(obj1, obj2, ...)
**l.ARMA**

Evaluate an ARMA TSmodel

**Description**

Evaluate an ARMA TSmodel.

**Usage**

```r
l(obj1, obj2, sampleT=NULL, predictT=NULL, result=NULL, error.weights=0, compiled=.DSEflags()$COMPILED, warn=TRUE, return.debug.info=FALSE, ...)
```

**Arguments**

- **obj1**: an 'ARMA' 'TSmodel' object.
- **obj2**: a TSdata object.
- **sampleT**: an integer indicating the number of periods of data to use.
- **predictT**: an integer to what period forecasts should be extrapolated.
result if non-NULL then the returned value is only the sub-element indicated by result.
result can be a character string or integer.

error.weights a vector of weights to be applied to the squared prediction errors.

compiled indicates if a call should be made to the compiled code for computation. A FALSE value is mainly for testing purposes.

warn if FALSE then certain warning messages are turned off.

return.debug.info logical indicating if additional debugging information should be returned.

... (further arguments, currently disregarded).

Details

This function is called by the function l() when the argument to l is an ARMA model (see ARMA). Using l() is usually preferable to calling l.ARMA directly. l.ARMA calls a compiled program unless compiled=FALSE. The compiled version is much faster.

sampleT is the length of data which should be used to calculate the one-step ahead predictions, and likelihood value for the model: Output data must be at least as long as sampleT. If sampleT is not supplied it is taken to be Tobs(data).

Input data must be at least as long as predictT. predictT must be at least as large as sampleT. If predictT is not supplied it is taken to be sampleT.

If error.weights is greater than zero then weighted prediction errors are calculated up to the horizon indicated by the length of error.weights. The weights are applied to the squared error at each period ahead.

Value

An object of class TSestModel (see TSestModel) containing the calculated likelihood, prediction, etc. for ARMA model.

See Also

ARMA l l.SS TSmodel TSestModel.object

Examples

data("eg1.DSE.data.diff", package="dse")
model <- TSmodel(estVARXls(eg1.DSE.data.diff))
evaluated.model <- l(model, eg1.DSE.data.diff)
Evaluate a state space TSmodel

Description

Evaluate a state space TSmodel.

Usage

```r
## S3 method for class 'SS'
1(obj1, obj2, sampleT=NULL, predictT=NULL, error.weights=0,
  return.state=FALSE, return.track=FALSE, result=NULL,
  compiled=.DSEflags()$COMPILED,
  warn=TRUE, return.debug.info=FALSE, ...)
```

Arguments

- `obj1`: An 'SS' 'TSmodel' object.
- `obj2`: A TSdata object.
- `sampleT`: an integer indicating the last data point to use for one step ahead filter estimation. If NULL all available data is used.
- `predictT`: an integer indicating how far past the end of the sample predictions should be made. For models with an input, input data must be provided up to predictT. Output data is necessary only to sampleT. If NULL predictT is set to sampleT.
- `error.weights`: a vector of weights to be applied to the squared prediction errors.
- `return.state`: if TRUE the element `filter$state` containing $E[z(t)|y(t-1), u(t)]$ is returned as part of the result. This can be a fairly large matrix.
- `return.track`: if TRUE the element `filter$track` containing the expectation of the tracking error given $y(t-1)$ and $u(t)$ is returned as part of the result. This can be an very large array.
- `result`: if result is not specified an object of class TSestModel is returned. Otherwise, the specified element of TSestModel$estimates is returned.
- `compiled`: if TRUE the compiled version of the code is used. Otherwise the S/R version is used.
- `warn`: if FALSE then certain warning messages are turned off.
- `return.debug.info`: logical indicating if additional debugging information should be returned.
- `...`: (further arguments, currently disregarded).
Details

This function is called by the function l() when the argument to l is a state space model. Using l() is usually preferable to calling l.SS directly. l.SS calls a compiled program unless compiled=FALSE. The compiled version is much faster than the S version.

Output data must be at least as long as sampleT. If sampleT is not supplied it is taken to be Tobs(data).

Input data must be at least as long as predictT. predictT must be at least as large as sampleT. If predictT is not supplied it is taken to be sampleT.

If error.weights is greater than zero then weighted prediction errors are calculated up to the horizon indicated by the length of error.weights. The weights are applied to the squared error at each period ahead.

sampleT is the length of data which should be used for calculating one step ahead predictions. y must be at least as long as sampleT. If predictT is large than sampleT then the model is simulated to predictT. y is used if it is long enough. u must be at least as long as predictT. The default result=0 returns a list of all the results. Otherwise only the indicated list element is return (eg. result=1 return the likelihood and result=3 returns the one step ahead predictions.

If z0 is supplied in the model object it is used as the estimate of the state at time 0. If not supplied it is set to zero.

If rootP0 is supplied in the model object then t(rootP0) %*% rootP0 is used as P0. If P0 is supplied or calculated from rootP0 in the model object, it is used as the initial tracking error P(t=1|t=0). If not supplied it is set to the identity matrix.

Additional objects in the result are Om is the estimated output cov matrix. pred is the time series of the one-step ahead predictions, E[y(t)|y(t-1),u(t)]. The series of prediction error is given by y - pred If error.weights is greater than zero then weighted prediction errors are calculated up to the horizon indicated by the length of error.weights. The weights are applied to the squared error at each period ahead. trackError is the time series of P, the one step ahead estimate of the state tracking error matrix at each period, Cov(z(t)-E[z(t)|t-1]) The tracking error can only be calculated if Q and R are provided (i.e. non innovations form models). Using the Kalman Innov K directly these are not necessary for the likelihood calculation, but the tracking error cannot be calculated.

Value

Usually an object of class TSestModel (see TSestModel), but see result above.

References


See Also

SS l l.ARMA TSmodel TSestModel TSestModel.object state smoother

Examples

data("eg1.DSE.data.diff", package="dse")
model <- toSS(TSmodel(estVARXls(eg1.DSE.data.diff)))
lmodel <- l(model,eg1.DSE.data.diff)
```r
summary(lmodel)
tfplot(lmodel)
lmodel <- lmodel.smt1DSE.data.diff, return.state=TRUE)
tfplot(state(lmodel, filter=TRUE))
```

### markovParms

#### Markov Parameters

**Description**

Construct a Matrix of the Markov Parameters

**Usage**

```r
markovParms(model, blocks=NULL)
```

**Arguments**

- `model`: An ARMA or SS TSmodel.
- `blocks`: Number of blocks to calculate.

**Details**

Construct a matrix with partitions \([M_0|...|M_i]\) giving the Markov parameters \(M_i\), \(i+1 = \text{blocks}\) where each \(M_i\) is a \(p\) by \((m+p)\) matrix, \(m\) is the dimension of the exogeneous series and \(p\) is the dimension of endogeneous series) ie. \(y(t) = e(t) + M [u'(t)|y'(t-1) | u'(t-1)|y'(t-2)]\) This requires that models be transformed so that lagged endogeneous variables are inputs. See Mittnik p1190. If blocks=NULL (the default) then at least 3 blocks are generated, and up to n+1, but the series is truncated if the blocks are effectively zero. This will affect the size of the Hankel matrix.

**Value**

A matrix

**References**

See references for `MittnikReduction`.

**See Also**

- `SVDbalanceMittnik`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXs1s(eg1.DSE.data.diff)
markovParms(model)
```
McMillanDegree  

**Calculate McMillan Degree**

**Description**

Calculate the McMillan degree of an ARMA TSmodel.

**Usage**

```r
McMillanDegree(model, ...)  
## S3 method for class 'ARMA'
McMillanDegree(model, fuzz=1e-4, verbose=TRUE, warn=TRUE, ...)  
## S3 method for class 'SS'
McMillanDegree(model, fuzz=1e-4, ...)  
## S3 method for class 'TSestModel'
McMillanDegree(model, ...)  
```

**Arguments**

- `model`: An object of class TSmodel.
- `fuzz`: Roots within fuzz distance are counted as equivalent.
- `verbose`: If TRUE roots are printed.
- `warn`: If FALSE then warnings about unit roots added for TREND are not printed.
- `...`: arguments to be passed to other methods.

**Value**

A list with elements `gross` and `distinct` containing all roots and distinct roots.

**Side Effects**

The number of roots and distinct roots is printed if `verbose` is TRUE.

**See Also**

- `stability`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")  
model <- estVARXls(eg1.DSE.data.diff)  
McMillanDegree(model)  
```
minForecastCov

**Description**

Extract the minimum forecastCov at each horizon

**Usage**

`minForecastCov(obj, series=1, verbose=TRUE)`

**Arguments**

- `obj`: An object as returned by `stripMine`.
- `series`: An indicator of the series which are to be used as the bases for selection.
- `verbose`: If true additional information is printed.

**Details**

Select the min covariance (for series only!) at each horizon and print. The returned object is a vector indicating the element of forecastCov which was the min at each horizon. It is suitable as an argument to plot eg: `tfplot(obj, select.cov=minForecastCov(obj))` The results of this plot are similar to the default results of `tfplot(selectForecastCov(obj))`. Covariance information and information about the horizon where the model is optimal are given.

**Value**

The returned object is a vector indicating the element of forecastCov which was the min at each horizon.

**See Also**

`selectForecastCov`, `excludeForecastCov`

**Examples**

```r
data("eg1.DSE.data.diff", package="dse")
z <- stripMine(eg1.DSE.data.diff, essential.data=c(1,2),
estimation.methods=list(estVARXls=list(max.lag=3)))
z <- minForecastCov(z)
```
minimumStartupLag

### Description

Number of Starting Periods Required for a Model

### Usage

```r
minimumStartupLag(model)
## S3 method for class 'SS'
minimumStartupLag(model)
## S3 method for class 'ARMA'
minimumStartupLag(model)
## S3 method for class 'TSestModel'
minimumStartupLag(model)
startShift(model, data, y0=NULL)
```

### Arguments

- **model**
  - A TSmodel or object containing a TSmodel.
- **data**
  - A TSdata object.
- **y0**
  - initial condition ...

### Details

For many time series models several starting data points are required before output from the model can be calculated (or makes sense). This generic function extracts or calculates that number of periods.

### Value

An integer.

### Note

There is some redundancy between this and startShift which should be cleaned up.

### See Also

- TSmodel
MittnikReducedModels  Reduced Models via Mittnik SVD balancing

Description
Reduced Models via Mittnik SVD balancing.

Usage
MittnikReducedModels(largeModel)

Arguments
largeModel  An SS TSmodel.

Details
The largeModel is balanced by the SVD method promoted by Mittnik (see MittnikReduction) and then models for every state dimension up to the state dimension of the largeModel are return. Note that this procedure does not result in smaller models which are balanced.

Value
A list of state space TSmodels with smaller state dimensions.

See Also
MittnikReduction

Examples

data("eg1.DSE.data.diff", package="dse")
z <- MittnikReducedModels(toSS(estVARXls(eg1.DSE.data.diff)))

MittnikReduction  Balance and Reduce a Model

Description
Balance and reduce the state dimension of a state space model a la Mittnik.

Usage
MittnikReduction(model, data=NULL, criterion=NULL, verbose=TRUE, warn=TRUE)
MittnikReduction.from.Hankel(M, data=NULL, nMax=NULL, criterion=NULL, verbose=TRUE, warn=TRUE)
Arguments

model
An object of class TSmodel or TSestModel.
data
If the supplied model is of class TSestModel and data is not supplied then it is taken from the model. If the model is of class TSmodel then data must be supplied.
criterion
Criterion to be used for model selection. see informationTestsCalculations.
verbose
logical indicating if information should be printed during estimation.
warn
logical indicating if some warning messages should be suppressed.
M
a matrix. See details.
nMax
integer indicating the state dimension of the largest model considered.

Details

MittnikReduction gives nested-balanced state space model using reduction by svd of the Hankel matrix generated from a model. If a state space model is supplied the max. state dimension for the result is taken from the model. If an ARMA model is supplied then singular values will be printed and the program prompts for the max. state dimension. criterion should be the name of one of the values returned by informationTests, that is, one of ("port","like","aic","bic","gvc","rice","fpe","taic", "tbic","tgvc","trice","tfpe"). If criteria is not specified then the program prompts for the state dimension (n) to use for the returned model. The program requires data to calculate selection criteria. (The program balanceMittnik calculates svd criteria only and can be used for reduction without data.)

The function MittnikReduction.from.Hankel is called by MittnikReduction and typically not by the user, but there are situations when the former might be called directly. It selects a reduced state space model by svd a la Mittnik. Models and several criteria for all state dimensions up to the max. state dim. specified are calculated. (If nMax is not supplied then svd criteria are printed and the program prompts for nMax). The output dimension p is taken from nrow(M). M is a matrix with p x (m+p) blocks giving the markov parameters, that is, the first row of the Hankel matrix. It can be generated from the model as in the function markovParms, or from the data, as in the function estSSMittnik.

data is necessary only if criteria (AIC,etc) are to be calculated.

Value

A state space model balance a la Mittnik in an object of class TSestModel.

References


**See Also**

`estVARXls` `bft` `balanceMittnik` `informationTests` `informationTestsCalculations`

**Examples**

```r
data(“egJofF.1dec93.data”, package=“dse”)
model <- toSS(estVARXls(egJofF.1dec93.data))
newmodel <- MittnikReduction(model, criterion=“taic”)
```

---

**nseries.featherForecasts**

*Number of Series*

**Description**

Return the number of series.

**Usage**

```r
## S3 method for class ‘featherForecasts’
nseries(x)
```

**Arguments**

- `x` A featherForecasts object.

**Details**

See the generic method.

**Value**

An integer.
nseriesInput  Number of Series in Input or Output

Description

Number of input or output series in a TSdata object.

Usage

nseriesInput(x)
## Default S3 method:
  nseriesInput(x)
## S3 method for class 'TSdata'
  nseriesInput(x)
## S3 method for class 'SS'
  nseriesInput(x)
## S3 method for class 'ARMA'
  nseriesInput(x)
## S3 method for class 'TSestModel'
  nseriesInput(x)

nseriesOutput(x)
## Default S3 method:
  nseriesOutput(x)
## S3 method for class 'TSdata'
  nseriesOutput(x)
## S3 method for class 'SS'
  nseriesOutput(x)
## S3 method for class 'ARMA'
  nseriesOutput(x)
## S3 method for class 'TSestModel'
  nseriesOutput(x)

Arguments

  x  Object of class TSdata, TSmodel or TSestModel.

Value

An integer indicating the number of series.

See Also

seriesNamesInput seriesNamesOutput
examples

```r
data("eg1.DSE.data", package="dse")
nseriesOutput(eg1.DSE.data)
```

---

## nstates

### State Dimension of a State Space Model

#### Description

Extract the state dimension of a state space model object.

#### Usage

```r
nstates(x)
## S3 method for class 'SS'
nstates(x)
## S3 method for class 'ARMA'
nstates(x)
## S3 method for class 'TSestModel'
nstates(x)
```

#### Arguments

- `x` Object of class TSmodel or TSestModel.

#### Value

An integer indicating the state dimension.

#### See Also

- `nseriesInput`

---

## observability

### Calculate Model Observability Matrix

#### Description

Calculate the singular values of the observability matrix of a model.
outOfSample.forecastCovEstimatorsWRTdata

Usage

  observability(model)
  ## S3 method for class 'ARMA'
  observability(model)
  ## S3 method for class 'SS'
  observability(model)
  ## S3 method for class 'TSestModel'
  observability(model)

Arguments

  model    An object containing a TSmodel.

Details

  If all singular values are significantly different from zero the model is observable.

Value

  The singular values of the observability matrix.

See Also

  reachability, stability McMillanDegree

Examples

  data("eg1.DSE.data.diff", package="dse")
  model <- toSS(estVARXls(eg1.DSE.data.diff))
  observability(model)

outOfSample.forecastCovEstimatorsWRTdata

Calculate Out-of-Sample Forecasts

Description

  Calculate out-of-sample forecasts.

Usage

  outOfSample.forecastCovEstimatorsWRTdata(data, zero=FALSE, trend=FALSE,
    estimation.sample=.5, horizons=1:12, quiet=FALSE,
    estimation.methods=NULL, compiled=.DSEflags()$COMPILED)
percentChange.TSdata

Arguments

data an object of class TSdata.
estimation.methods a list as used by estimateModels.
zero if TRUE then forecastCov is also calculated for a forecast of zero.
trend if TRUE then forecastCov is also calculated for a forecast of a linear trend.
estimation.sample indicates the portion of the data to use for estimation. If estimation.sample is an integer then it is used to indicate the number of points in the sample to use for estimation. If it is a fraction it is used to indicate the portion of points to use for estimation. The remainder of the sample is used for evaluating forecasts.
horizons horizons for which forecast covariance should be calculated.
quiet if TRUE then estimation information is not printed.
compiled a logical indicating if compiled code should be used. (Usually true except for debugging.)

Details

The data is split into a sub-sample used for estimation and another sub-sample used for calculating the forecast covariance.

Value

An object as returned by forecastCovEstimatorsWRTdata.

See Also

forecastCovEstimatorsWRTdata, forecastCovEstimatorsWRTtrue, estimateModels

Examples

data("eg1.DSE.data.diff", package="dse")
z <- outOfSample.forecastCovEstimatorsWRTdata(eg1.DSE.data.diff,
    estimation.methods=list(estVARXls=list(max.lag=4)))

---

percentChange.TSdata Calculate percent change

Description

Calculate the percent change relative to the data lag periods prior.
Usage

## S3 method for class 'TSdata'
percentChange(obj, base=NULL, lag=1, cumulate=FALSE, e=FALSE, ...)
## S3 method for class 'TSestModel'
percentChange(obj, base=NULL, lag=1, cumulate=FALSE, e=FALSE, ...)

Arguments

- **obj**: An object of class TSdata or TSestModel
- **e**: see the default method.
- **base**: see the default method.
- **lag**: see the default method.
- **cumulate**: see the default method.
- **...**: arguments passed to other methods.

Details

See percentChange.

Value

For an object of class TSdata the percent change calculation is done with the output data and the result is an object of class TSdata (or a list of objects of class TSdata). For an object of class TSestModel the percent change calculation is done with estimates$pred and the result is an object of class TSdata (or a list of objects of class TSdata).

See Also

percentChange ytoypc

Examples

data("eg1.DSE.data", package="dse")
z <- percentChange(outputData(eg1.DSE.data))

---

permute | Permuted
---------|----------

Description

Return matrix with rows indicating all possible selections of elements from seq(M). 0 in the result indicates omit. M is usually a positive integer. M=0 gives NULL. Neg. M give -permute(abs(M)).

Usage

permute(M)
Arguments

M An integer.

Value

A matrix.

Examples

permute(4)

data("egJoff.1dec93.data", package="dse")
phasePlots(egJoff.1dec93.data)

Description

Calculate phase plots

Usage

phasePlots(data, max.lag=1,diff=FALSE)

Arguments

data A matrix, time series matrix, or an object of class TSdata.
max.lag The maximum number of shifts to plot
diff If TRUE the data is plotted against the difference with lagged values.

Details

Non-linearities may show up as a non-linear surface, but this is a projection so, for example, a spherical space would not show up. Some sort of cross-section window would show this but require even more plots. A good statistical test would be better!

Value

None

Side Effects

A plot of (the phase space) the data against (differenced) lagged values is produced.

Examples

data("egJoff.1dec93.data", package="dse")
phasePlots(egJoff.1dec93.data)
plot.roots  

Plot Model Roots

Description

Calculate and plot roots of a model.

Usage

## S3 method for class 'roots'
plot(x, pch=*, fuzz=0, ...)

Arguments

x  
An object of class roots (a vector of complex (or real) values as returned by the function roots).

pch  
character to be used for the plot (passed to plot.default).

fuzz  
If non-zero then roots within fuzz distance are considered equal.

...  
(further arguments, currently disregarded).

Value

The eigenvalues of the state transition matrix or the inverse of the roots of the determinant of the AR polynomial are returned invisibly.

Side Effects

The roots and a unit circle are plotted on the complex plane.

See Also

addPlotRoots roots stability McMillanDegree

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
plot(roots(model))
Polynomials

Polynomial Utilities

Description

Polynomial utility functions used by DSE.

Usage

characteristicPoly(a)
companionMatrix(a)
polyvalue(coef, z)
polydet(a)
polyprod(a, b)
polysum(a, b)
polyrootDet(a)

Arguments

a             An array representing a matrix polynomial.
b             An array representing a matrix polynomial.
coef          Coefficients of a polynomial.
z             Value at which the polynomial is to be evaluated.

Details

These are utility functions used in some ARMA model calculations such as root and stability calculations.

Value

depends

See Also

polyroot roots stability
Portmanteau

*Calculate Portmanteau statistic*

**Description**

Calculate Portmanteau statistic.

**Usage**

```r
Portmanteau(res)
```

**Arguments**

- `res` A matrix with time-series residuals in columns.

**See Also**

`informationTests`

**Examples**

```r
require("stats")
Portmanteau(matrix(rnorm(200), 100,2)) # but typically with a residual
```

---

**print.forecastCov**

*Print Specific Methods*

**Description**

See the generic function description.

**Usage**

```r
## S3 method for class 'estimatedModels'
print(x, digits=options()$digits, ...)
## S3 method for class 'forecastCov'
print(x, digits=options()$digits, ...)
## S3 method for class 'forecastCovEstimatorsWRTdata.subsets'
print(x, digits=options()$digits, ...)
## S3 method for class 'forecastCovEstimatorsWRTtrue'
print(x, digits=options()$digits, ...)
```

**Arguments**

- `x` an object to be printed.
- `digits` a non-null value is used to indicate the number of significant digits. If digits is NULL then the value of digits specified by options is used.
- `...` (further arguments, currently disregarded).
print.TSdata

See Also

print summary

print.TSdata  

Print Specific Methods

Description

See the generic function description.

Usage

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

Arguments

x  
An object of class TSdata.

...  
arguments to be passed to other methods.

See Also

print summary

print.TSestModel  

Display TSmodel Arrays

Description

Display TSmodel arrays.

Usage

## S3 method for class 'SS'
print(x, digits=options()$digits, latex=FALSE, ...)

## S3 method for class 'ARMA'
print(x, digits=options()$digits, latex=FALSE, L=TRUE, fuzz=1e-10, ...)

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

Arguments

- **x**: An object of class TSmodel or TSestModel.
- **digits**: the number of significant digits
- **L**: logical if TRUE then ARMA model arrays are displayed as a polynomial matrix with L indicating lags. Otherwise, each lag in the array is displayed as a matrix.
- **latex**: logical. If TRUE additional context is added to make the output suitable for inclusion in a latex document.
- **fuzz**: ARMA model polynomial elements with absolute value less than fuzz are not displayed (i.e.-as if they are zero)
- **...**: arguments passed to other methods.

Value

The object is returned invisibly.

Side Effects

The model arrays are displayed.

Note

BUG: digits cannot be controlled for some numbers (e.g.- 1.0 is printed as 0.9999999999)

See Also

- `print`, `summary`

Examples

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
print(model)
print(model, digits=3)
print(model, digits=3, fuzz=0.001)
print(model, digits=3, fuzz=0.001, latex=TRUE)
```

Description

Calculate the singular values of the reachability matrix of a model.
residualStats 79

Usage

reachability(model)
  ## S3 method for class 'ARMA'
reachability(model)
  ## S3 method for class 'SS'
reachability(model)
  ## S3 method for class 'TSestModel'
reachability(model)

Arguments

model An object containing TSmodel.

Details

If all singular values are significantly different from zero the model is controllable.

Value

The singular values of the reachability matrix.

See Also

observability, stability roots McMillanDegree

Examples

data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARXls(eg1.DSE.data.diff))
reachability(model)

residualStats  Calculate Residuals Statistics and Likelihood

Description

Calculate the residuals statistics and likelihood of a residual.

Usage

residualStats(pred, data, sampleT=nrow(pred), warn=TRUE)

Arguments

pred A matrix with columns representing time series.
data A matrix with columns representing time series.
sampleT An integer indicating the sample to use.
warn If FALSE certain warnings are suppressed.
Details

Residuals are calculated as `pred[1:sampleT,drop=FALSE] - data[1:sampleT,drop=FALSE]` and then statistics are calculated based on these residuals. If `pred` or `data` are `NULL` they are treated as zero.

Value

A list with elements like, `cov`, `pred`, and `sampleT`. `pred` and `sampleT` are as supplied (and are returned as this is a utility function called by other functions and it is convenient to pass them along). `cov` is the covariance of the residual and `like` is a vector of four elements representing the total, constant, determinant and covariance terms of the negative log likelihood function.

See Also

1

Examples

```r
residualStats(matrix(rnorm(200), 100, 2), NULL) # but typically used for a residual
```

---

**Riccati**

### Riccati Equation

**Description**

Solve a Matrix Riccati Equation

**Usage**

```r
Riccati(A, B, fuzz=1e-10, iterative=FALSE)
```

**Arguments**

- **A**: A matrix.
- **B**: A matrix.
- **fuzz**: The tolerance used for testing convergence.
- **iterative**: If TRUE an iterative solution technique is used.

**Details**

Solve Riccati equation $P = APA' + B$ by eigenvalue decompostion of a symplectic matrix or by iteration.

**Value**

`xxx`
Note

This procedure has not been tested.

References


See Also

eigen

---

roots

*Calculate Model Roots*

Description

Calculate roots of a TSmodel.

Usage

```r
roots(obj, ...) ## S3 method for class 'SS'

roots(obj, fuzz=0, randomize=FALSE, ...) ## S3 method for class 'ARMA'

roots(obj, fuzz=0, randomize=FALSE, warn=TRUE, by.poly=FALSE, ...) ## S3 method for class 'TSestModel'

roots(obj, ...)
```

Arguments

- `obj` An object of class TSmodel.
- `fuzz` If non-zero then roots within fuzz distance are considered equal.
- `randomize` Randomly arrange complex pairs of roots so the one with the positive imaginary part is not always first (so random experiments are not biased).
- `warn` If FALSE then warnings about unit roots added for TREND are not printed.
If TRUE then roots are calculated by expanding the determinant of the A polynomial. Otherwise, they are calculated by converting to a state space representation and calculating the eigenvalues of F. This second method is preferable for speed, accuracy, and because of a limitation in the degree of a polynomial which can be handled by polyroot.

... arguments passed to other methods.

Details

The equality of roots for equivalent state space and ARMA models is illustrated in Gilbert (1993). The calculation of ARMA model roots is more stable if the model is converted to state space and the roots calculated from the state transition matrix (see Gilbert, 2000). The calculation is done this way by default. If by.poly=TRUE then the determinant of the AR polynomial is expanded to get the roots.

Value

The eigenvalues of the state transition matrix or the inverse of the roots of the determinant of the AR polynomial are returned.

References


See Also

stability, McMillanDegree

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
roots(model)

roots.estimatedModels  Roots Specific Methods

Description

See the generic function description.
## Usage

```r
## S3 method for class 'estimatedModels'
roots(obj, digits=options()$digits, mod = FALSE, ...)

## S3 method for class 'forecastCovEstimatorsWRTtrue'
roots(obj, digits=options()$digits, mod = FALSE, ...)
```

### Arguments

- **obj**: an object from which roots are to be extracted or calculated and printed.
- **digits**: an integer indicating the number of significant digits to be printed (passed to the print method).
- **mod**: if TRUE the modulus of the roots is calculated. Otherwise, a complex value may result.
- **...**: arguments to be passed to other methods.

### Details

The methods ***.ee are intended mainly to be called from EstEval in the `EvalEst` as criterion for evaluating an estimation method.

### See Also

- `roots`
- `stability`
- `EstEval`

---

### scale.TSdata

#### Scale Methods for TS objects

#### Description

Scale data or a model by a given factor.

#### Usage

```r
## S3 method for class 'TSdata'
scale(x, center = FALSE, scale = NULL)

## S3 method for class 'TSeestModel'
scale(x, center = FALSE, scale = NULL)

## S3 method for class 'ARMA'
scale(x, center = FALSE, scale = NULL)

## S3 method for class 'innov'
scale(x, center = FALSE, scale = NULL)

## S3 method for class 'nonInnov'
scale(x, center = FALSE, scale = NULL)

checkScale(x, scale)
```
checkScale(x, scale)

Arguments

- **x**: TSdata, TSmodel or an object containing these.
- **center**: to match generic arguments, not currently used.
- **scale**: A list with two matrices or vectors, named input and output, giving the multiplication factor for inputs and outputs. Vectors are treated as diagonal matrices. `scale$input` can be NULL if no transformation is to be applied (or the data or model has no input.)

Value

The resulting data or model is different from the original in proportion to `scale`. i.e. if S and T are output and input scaling matrices then y'(t) = S y(t) where y' is the new output u'(t) = S u(t) where u' is the new input.

For models the result has inputs and outputs (and innovations) which are scaled as if data scaling had been applied to them as above. Thus if the input and output scales are diagonal matrices or scalars the plot of the predictions and residuals for `l(scale(model,scale=somescale), scale(data, scale=somescale))` while have the same appearance as `l(model, data)` but will be scaled differently.

See Also

- `scale`

Examples

data("eg1.DSE.data.diff", package="dse")
# This is a simple example. Usually scale would have something
# to do with the magnitude of the data.
z <- scale(eg1.DSE.data.diff,
    scale=list(input=rep(2, nseriesInput(eg1.DSE.data.diff)),
               output=rep(2, nseriesOutput(eg1.DSE.data.diff))))
model <- estVARXls(eg1.DSE.data.diff)
model <- scale(model,
    scale=list(input=rep(2, nseriesInput(eg1.DSE.data.diff)),
               output=rep(2, nseriesOutput(eg1.DSE.data.diff))))
selectForecastCov

Select Forecast Covariances Meeting Criteria

Description
Select forecast covariances meeting given criteria.

Usage
selectForecastCov(obj, series=1,
select.cov.best=1,
select.cov.bound=NULL,
ranked.on.cov.bound=NULL,
verbose=TRUE)

Arguments
obj               an object as returned by stripMine.
series            an indication of series to which the tests should be applied.
select.cov.best   the number of 'best' forecasts to select.
select.cov.bound  a bound to use as criteria for selection.
ranked.on.cov.bound see details.
verbose           if verbose=TRUE then summary results are printed.

Details
Select models with forecast covariance for series meeting criteria. The default select.cov.best=1
selects the best model at each horizon. select.cov.best=3 would select the best 3 models at
each horizon. If select.cov.bound is not NULL then select.cov.best is ignored and any model
which is better than the bound at all horizons is selected. select.cov.bound can be a vector of the
same length as series, in which case corresponding elements are applied to the different series.
Any model which is better than the bound at all horizons is selected. ranked.on.cov.bound should be a positive integer. The forecast covariances are ranked by there
maximum over the horizon and the lowest number up to ranked.on.cov.bound are selected. This
amounts to adjusting the covariance bound to allow for the given number of models to be selected. If
series is a vector the results are the best up to the given number on any series! select.cov.bound
can be a vector of the same length as series, in which case corresponding elements are applied
to the different series. If verbose=TRUE then summary results are printed. The returned result is a
forecastCov object like obj, but filtered to remove models which do not meet criteria.

Value
The returned result is a forecastCov object like obj, but filtered to remove models which do not meet
criteria.
See Also

\texttt{minForecastCov}, \texttt{excludeForecastCov}

Examples

data("eg1.DSE.data.diff", package="dse")
z <- stripMine(eg1.DSE.data.diff, essential.data=c(1,2),
estimation.methods=list(estVARXls=list(max.lag=3)))
z <- selectForecastCov(z)
tfplot(selectForecastCov(z, select.cov.bound=20000))
tfplot(selectForecastCov(z, select.cov.best=1))

\begin{verbatim}
seriesNames.TSdata  Series Names Specific Methods
\end{verbatim}

Description

See the generic function description.

Usage

\begin{verbatim}
## S3 method for class 'TSdata'
seriesNames(x)
## S3 method for class 'TSmodel'
seriesNames(x)
## S3 method for class 'TSestModel'
seriesNames(x)

## S3 replacement method for class 'TSdata'
seriesNames(x) <- value
## S3 replacement method for class 'TSmodel'
seriesNames(x) <- value
## S3 replacement method for class 'TSestModel'
seriesNames(x) <- value
\end{verbatim}

Arguments

\begin{verbatim}
x  an object from which series names can be extracted or to which series names are to be assigned.
value  series names to be assigned to data.
\end{verbatim}

See Also

\texttt{seriesNames}
seriesNamesInput

**TSdata Series Names**

**Description**

Extract or set names of input or output series in a TSdata object.

**Usage**

```r
seriesNamesInput(x)
## S3 method for class 'TSdata'
seriesNamesInput(x)
## S3 method for class 'TSmodel'
seriesNamesInput(x)
## S3 method for class 'TSestModel'
seriesNamesInput(x)

seriesNamesOutput(x)
## S3 method for class 'TSdata'
seriesNamesOutput(x)
## S3 method for class 'TSmodel'
seriesNamesOutput(x)
## S3 method for class 'TSestModel'
seriesNamesOutput(x)

seriesNamesInput(x) <- value
seriesNamesOutput(x) <- value
```

**Arguments**

- `x` Object of class TSdata, TSmodel or TSestModel.
- `value` value to be assigned to object.

**Value**

The first usages gives a vector of strings with the series names. The second usages assigns a vector of strings to be the series names of data.

**See Also**

- `seriesNames`

**Examples**

```r
data("eg1.DSE.data", package="dse")
seriesNamesOutput(eg1.DSE.data)
```
**TS Input and Output Specific Methods**

### seriesNamesInput.forecast

**Description**

See the generic function description.

**Usage**

```r
### S3 method for class 'forecast'
seriesNamesInput(x)
### S3 method for class 'featherForecasts'
seriesNamesInput(x)

### S3 method for class 'forecast'
seriesNamesOutput(x)
### S3 method for class 'featherForecasts'
seriesNamesOutput(x)
```

**Arguments**

- **x**  
  An object from which to extract the names of the input or output series.

---

**shockDecomposition**

**Shock Decomposition**

### Description

Graphs of the effect of shocks are plotted.

### Usage

```r
shockDecomposition(model, horizon=30, shock=rep(1, horizon))
```

**Arguments**

- **model**  
  An object of class TSmodel or TSestModel.
- **horizon**  
  The number of periods for which to calculate the effect of shocks.
- **shock**  
  data to be used model output. See details.

**Details**

All output data is set to zero and then each output in turn is switched to a value of shock (default 1.0) for all periods.
Value
None

Side Effects
Graphs of the effect of shocks are plotted.

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
shockDecomposition(model)

simulate

Simulate a TSmodel

Description
Simulate a model to produce artificial data.

Usage

simulate(model, ...)  
## S3 method for class 'ARMA'
simulate(model, y0=NULL, input=NULL, input0=NULL,  
         start=NULL, freq=NULL, sampleT=100, noise=NULL, sd=1, Cov=NULL,  
         rng=NULL, noise.model=NULL, compiled=.DSEflags()$COMPILED, ...)

## S3 method for class 'SS'
simulate(model, input=NULL,  
         start=NULL, freq=NULL, sampleT=100, noise=NULL, sd=1, Cov=NULL,  
         rng=NULL, compiled=.DSEflags()$COMPILED, ...)

## S3 method for class 'TSestModel'
simulate(model, input=inputData(model),  
         sd=NULL, Cov=NULL, ...)

Arguments

model An object of class TSmodel or TSestModel.
input Data for the exogenous variable if specified in the model.
sampleT The length of the sample to simulate.
start start date for resulting data.
freq freq for resulting data.
y0, input0 Lagged values prior to t=1 for y and u, in reverse order so y[0][1] and input[0][1] correspond to t=0. These arguments are not implemented for state space models. If not specified initial values are set to zero.
simulate

noise

Noise can be supplied. Otherwise it will be generated. If supplied it should be a list as described below in details.

Cov

The covariance of the noise process. If this is specified then sd is ignored. A vector or scalar is treated as a diagonal matrix. For an object of class TStestModel, if neither Cov nor sd are specified, then Cov is set to the estimated covariance (model$estimates$cov).

sd

The standard deviation of the noise. This can be a vector.

noise.model

A TSmodel to be used for generating noise (not yet supported by SS methods).

rng

The random number generator information needed to regenerate a simulation.

compiled

Specifies the compiled version of the code should be used (instead of the S code version).

... arguments passed to other methods.

Details

A state space or ARMA model (see TSmodel, ARMA, and SS for more details) is simulated with pseudo random noise (The default noise is a normally distributed processes. An object of class TSdata is returned. This can be used as input to estimation algorithms. If start and freq are specified, or if input or noise$w (in that order) have time series properties, these are given to the output.

If noise is not supplied then random values will be generated using other supplied information or defaults. The rng will be set first if it is specified.

The default noise generation will be N(0,I) If Q is not square in a non innovations state space model (i.e. the system noise has a dimension less than the state dimension), then it is padded with zeros, so generated noise of higher dimension has no effect. If sd is supplied, then w as describe below will be N(0,sqr(sd)). sd can be a vector of p elements corresponding to each of the p outputs.

If noise is supplied it should be a list of the necessary noise processes. For non-innovation form state space models the list must have elements w, e, and w0. (w0 is w for t=0 in state space model and prior lags in ARMA models.) For innovation form state space models and ARMA models with MA components the list should have elements w and w0, but if w0 is not specified it is set to zero. For ARMA models with no MA components (i.e. VAR models) the list needs only w. In this case, and in the innovations form state space model with w0=0, a matrix may be supplied in place of a list. w should be a sampleT by p matrix giving the noise for t=1 to sampleT. If noise is specified sampleT will be set to the number of periods in w.

If noise$w0 is a matrix (rather than a vector) for a state space model simulation (as it is for ARMA simulations) then it is set to a vector of zeros. This provides compatibility with VAR models (ARMA models with no lags in B).

Input must be specified for ARMA models with model$C not NULL and state space models with model$G not NULL...

In general ARMA and SS simulations will not produce exactly the same results because it is impossible to determine necessary transformation of initial conditions and w0.

Value

The value returned is an object of class TSdata which can be supplied as an argument to estimation routines. (See TSdata). In addition to the usual elements (see the description of a TSdata object)
there are some additional elements: model- the generating model, rng - the initial RNG and seed, version - the version of S used (random number generators may vary) Cov as specified sd as specified noise - the noise details as provided in the argument or as generated. state - the state variable for state space models.

See Also

makeTSnoise, TSmodel, TSdata, ARMA, SS

Examples

mod1 <- ARMA(A=array(c(1,-.25,-.05), c(3,1,1)), B=array(c(1,c(1,1))))
AR <- array(c(1,.5,.3,0,.2,.1,0,.2,.05,1,.5,.3),c(3,2,2))
VAR <- ARMA(A=AR, B=diag(1,2))
print(VAR)
simData <- simulate(VAR)

C <- array(c(0.5,0,0,0.2),c(1,2,2))
VARX <- ARMA(A=AR, B=diag(1,2), C=C)
simData <- simulate(VARX, sampleT=150, input=matrix(rnorm(300),150,2))

MA <- array(c(1,.2,0,.1,0,1,.3),c(2,2,2))
ARMA <- ARMA(A=AR, B=MA, C=NULL)
simData <- simulate(ARMA, sampleT=200)

ARMAX <- ARMA(A=AR, B=MA, C=C)
simData <- simulate(ARMAX, sampleT=150, input=matrix(rnorm(300),150,2))

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
simData <- simulate(model)

ss <- SS(F=array(c(.5,.3,.2,.4), c(2,2)),
         H=array(c(1,0,0,1), c(2,2)),
         K=array(c(.5,.3,.2,.4), c(2,2)))
print(ss)
simData <- simulate(ss)

testEqual(simData, simulate(ss))
testEqual(simData, simulate(ss, rng=setRNG::getRNG(simData)))

simData2 <- simulate(ss,
                      noise=list(w=matrix(runif(300), 150,2), w0=runif(2)))
simData3 <- simulate(ss, noise=matrix(runif(400), 200,2))
**smoother**

*Evaluate a smoother with a TSmodel*

**Description**

Evaluate a state space model.

**Usage**

```
smoother(model, data, compiled=.DSEflags()$COMPILED)
```

---

### S3 method for class 'nonInnov'

```
smoother(model, data, compiled=.DSEflags()$COMPILED)
```

---

### S3 method for class 'TSmodel'

```
smoother(model, data, compiled=.DSEflags()$COMPILED)
```

---

### S3 method for class 'TSestModel'

```
smoother(model, data=TSdata(model),
         compiled=.DSEflags()$COMPILED)
```

**Arguments**

- **model**
  - An object of class `TSestModel` or `TSmodel` with a model of class `nonInnov` `SS` `TSmodel`. If filter information is not provided (i.e. in a TSestModel) then smoother runs the Kalman filter (l.SS) first.

- **data**
  - A TSdata object.

- **compiled**
  - If TRUE the compiled version of the code is used. Otherwise the S version is used.

**Details**

Calculate fixed interval smoother state values for a model. Smoother first runs the filter and uses the filtered state to calculate a smoothed estimate of the state (sometimes called a two sided filter). The smoother requires an non-innovations form model. The method for a TSmodel gives an error message if the model does not inherit from class nonInnov.

Note: this does not allow the same option as l.SS for calculating over a sub-sample. Smoothing is done over the length of the available filter data (which will be calculated to the length of the data if not supplied). For models with an input, smoothing will only be done over the input data period if that is shorter than the filter data.

See SS for details of the model:

\[
z(t) = Fz(t-1) + Gu(t) + Qe(t) \quad y(t) = Hz(t) + Rw(t)
\]

**Value**

An object of class TSestModel with an additional element smooth. smooth is a list of state, the smoothed state, and track, the smoothed tracking error. The result will also contain the element filter with state and track (which may or may not have been in the original argument).
References


See Also

`state.l, SS l.SS TSmodel TSestModel.object`

Examples

```r
data("eg1.DSE.data.diff", package="dse")
# smoother requires an non-innovations form model
model <- TSmodel(toSSChol(estVARXls(eg1.DSE.data.diff)))
smoothed.model <- smoother(model, eg1.DSE.data.diff, compiled=FALSE)
tfplot(state(smoothed.model))
tfplot(state(smoothed.model, filter=TRUE))
# compare
tfplot(state(smoothed.model, smoother=TRUE), state(smoothed.model, filter=TRUE))
```

SS

State Space Models

Description

Construct a

Usage

```r
SS(F=NULL, G=NULL, H=NULL, K=NULL, Q=NULL, R=NULL, z0=NULL, P0=NULL, rootP0=NULL, 
    constants=NULL, 
    description=NULL, names=NULL, input.names=NULL, output.names=NULL)
```

is.SS(obj)

is.innov.SS(obj)

is.nonInnov.SS(obj)

Arguments

F. (nxn) state transition matrix.

H (pxn) output matrix.

Q (nxn) matrix specifying the system noise distribution.

R (pxp) matrix specifying the output (measurement) noise distribution.

G (nxp) input (control) matrix. G should be NULL if there is no input.

K (nxp) matrix specifying the Kalman gain.
The state space (SS) model is defined by:

\[ z(t) = Fz(t-1) + Gu(t) + Qe(t) \]
\[ y(t) = Hz(t) + Rw(t) \]

or the innovations model:

\[ z(t) = Fz(t-1) + Gu(t) + Kw(t-1) \]
\[ y(t) = Hz(t) + w(t) \]

Matrices are as specified above in the arguments, and

- **y** is the p dimensional output data.
- **u** is the m dimensional exogenous (input) data.
- **z** is the n dimensional (estimated) state at time t, \( E[z(t)|y(t-1), u(t)] \) denoted \( E[z(t)|t-1] \). Note: In the case where there is no input u this corresponds to what usually be called the predicted state - not the filtered state. An initial value for z can be specified as \( z0 \) and an initial one step ahead state tracking error (for non-innovations models) as \( P0 \). In the object returned by \( l.ss \), state is a time series matrix corresponding to z.

**z0** An initial value for z can be specified as \( z0 \).

**P0** An initial one step ahead state tracking error (for non-innovations models) can be specified as \( P0 \).

**rootP0** Alternatively, a square root of \( P0 \) can be specified. This can be an upper triangular matrix so that only the required number of parameters are used.

**K, Q, R** For sub-class innov the Kalman gain K is specified but not Q and R. For sub-class non-innov Q and R are specified but not the Kalman gain K.

**e and w** are typically assumed to be white noise in the non-innovations form, in which case the covariance of the system noise is \( QQ' \) and the covariance of the measurement noise is \( RR' \). The covariance of e and w can be specified otherwise in the simulate method \( simulate.SS \) for this class of model, but the assumption is usually maintained when estimating models of this form (although, not by all authors).
stability

Typically, an non-innovations form is harder to identify than an innovations form. Non-innovations form would typically be chosen when there is considerable theoretical or physical knowledge of the system (e.g. the system was built from known components with measured physical values).

By default, elements in parameter matrices are treated as constants if they are exactly 1.0 or 0.0, and as parameters otherwise. A value of 1.001 would be treated as a parameter, and this is the easiest way to initialize an element which is not to be treated as a constant of value 1.0. Any matrix elements can be fixed to constants by specifying the list `constants`. Matrices which are not specified in the list will be treated in the default way. An alternative for fixing constants is the function `fixConstants`.

Value

An SS TSmodel

References


See Also

TSmodel ARMA simulate.SS l.SS state smoother fixConstants

Examples

```r
f <- array(c(.5,.3,.2,.4),c(2,2))
h <- array(c(1,0,0,1),c(2,2))
k <- array(c(.5,.3,.2,.4),c(2,2))
ss <- SS(F=f,G=NULL,H=h,K=k)
is.SS(ss)
ss
```

stability

*Calculate Stability of a TSmodel*

Description

Calculate roots and their modulus and indicate stability.

Usage

```r
stability(obj, fuzz=1e-4, eps=1e-15, digits=8, verbose=TRUE)
## S3 method for class 'ARMA'
stability(obj, fuzz=1e-4, eps=1e-15, digits=8, verbose=TRUE)
## S3 method for class 'roots'
stability(obj, fuzz=1e-4, eps=1e-15, digits=8, verbose=TRUE)
## S3 method for class 'TSmodel'
stability(obj, fuzz=1e-4, eps=1e-15, digits=8, verbose=TRUE)
## S3 method for class 'TSestModel'
stability(obj, fuzz=1e-4, eps=1e-15, digits=8, verbose=TRUE)
```
Arguments

- **obj**: An object of class TSmodel.
- **fuzz**: Roots within fuzz are considered equal.
- **eps**: Roots with modulus less than \((1-\text{eps})\) are considered stable.
- **digits**: Printing precision.
- **verbose**: Print roots and there moduli.

Details

The returned value is **TRUE** or **FALSE**, indicating if the model is stable or not. The result also has an attribute **roots** which is a matrix with the first (complex) column indicating the eigenvalues of the state transition matrix \(F\) for state space models, or the inverse of distinct roots of \(\det(A(L))\) for ARMA models, and the second column indicating the moduli of the roots.

The argument **eps** is used to prevent the indication of a stable model when the largest root is within rounding error of 1.0.

Value

**TRUE** or **FALSE** if the model is stable or not stable.

Side Effects

The eigenvalues of the state transition matrix or the roots of the determinant of the AR polynomial are printed if verbose is **T**.

See Also

- `McMillanDegree`

Examples

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
stability(model)
```

---

**state**

*Extract State*

Description

Extract state information from estimated SS model.

Usage

```r
state(obj, smoother=FALSE, filter=!smoother)
```
Arguments

obj An object of class ‘TSestModel’ with state information (filter or smoother) or containing an ‘SS’ model from which to estimate the state.

smoother logical indicating if the smoother state should be returned.

filter logical indicating if the filtered state should be returned.

Details

One and only one of smoother and filter should be TRUE).

Value

A time series matrix of the estimated state series.

See Also

smoother, SS, l.SS

---

stripMine Select a Data Subset and Model

Description

Select a data subset and model.

Usage

stripMine(all.data, essential.data=1, estimation.sample=.5, discard.before=1, horizons=1:12, quiet=FALSE, estimation.methods=NULL, step.size=NULL)

Arguments

all.data An object of class TSdata.

essential.data A vector indicating the important series.

estimation.sample The portion of the data to use for estimation.

discard.before Period before which data should be discarded when calculating the forecast covariances.

horizons Forecast horizons which should be considered.

quiet If T then estimation information is not printed. quiet=TRUE may also have to be set in the arguments to estimation methods.
estimation.methods

A list indicating the model estimation method to use. The list should contain one element. The name of the element indicates the estimation method to use and the value of the element is a list of arguments to pass to the estimation method.

step.size

An integer indicating how many data subset/model steps should be attempted. This may be necessary to accommodate memory constraints on the system. (See below.)

Details

Calculate the predictions cov for essential.data of models estimated with estimation methods indicated by estimation.methods. estimation.methods is a list with syntax similar to programs for comparing estimation methods (eg. estimateModels), BUT ONLY THE FIRST element (estimation method) is considered. Essential.data indicates the subset of output variables to included in all models. It should be a vector of the indices. All possible combinations of input series and other output series data are considered. If omitted, essential.data is taken as the first output series. Only forecast covariances for essential data are returned. discard.before is an integer indicating 1+the number of points in the beginning of predictions to discard for calculating prediction covariances. estimation.sample indicates the portion of the data to use for estimation. If estimation.sample is an integer then it is used to indicate the number of points in the sample to use for estimation. If it is a fraction it is used to indicate the portion of points to use for estimation. The remainder of the sample is used for evaluating predictions. If step.size is NULL then all possible data permutations are attempted. Because S has a hard-coded limit in the number of synchronize calls this is not always possible (For loops call synchronize.) An error message: Error in synchronize(1): No room in database table If step.size is not NULL it should be a positive integer. In this case variable permutations are divided up into steps of the given size. The result returned by the function can be used to continue from the last step: intermediate.result <- stripMine(data, ...) intermediate.result <- stripMine(intermediate.result) intermediate.result <- stripMine(intermediate.result) result <- stripMine(intermediate.result) This can be done either interactively or in a batch process, but cannot be done in a function because the database table is not cleared until the top level expression is complete. The class of an intermediate result is stripMine.intermediate.result and the class of the final result is c('forecastCovEstimatorsWRTdata.subsets', 'forecastCov') If the final result is used in a call to stripMine then it is just returned, so extra calls do not cause errors and are very quick. This is useful when you are too lazy to calculate the exact number of steps.

Value

The returned result contains a list (forecastCov) of the forecast covariance on the essential data for the various models and data subsets. It can be plotted with the generic function tfplot. Additional information in the result comes from the function arguments.

See Also

estBlackBox4

Examples

data("eg1.DSE.data.diff", package="dse")
z <- stripMine(eg1.DSE.data.diff,
estimation.methods=list(bft=list(max.lag=2, verbose=FALSE)))
Summary Specific Methods

Description

See the generic function description.

Usage

```r
## S3 method for class 'forecastCov'
summary(object, horizons = object$horizons,
         series = seq(nseriesOutput(object$data)), ...)
## S3 method for class 'forecastCovEstimatorsWRTdata.subsets'
summary(object, ...)
## S3 method for class 'forecastCovEstimatorsWRTtrue'
summary(object,
         digits = options()$digits, ...)
## S3 method for class 'estimatedModels'
summary(object, ...)
## S3 method for class 'summary.forecastCov'
print(x, digits = options()$digits, ...)
## S3 method for class 'summary.forecastCovEstimatorsWRTdata.subsets'
print(x,
      digits = options()$digits, ...)
## S3 method for class 'summary.forecastCovEstimatorsWRTtrue'
print(x,
      digits = options()$digits, ...)
## S3 method for class 'summary.estimatedModels'
print(x, digits = options()$digits, ...)
```

Arguments

- **object**
  - an object for which a summary is to be printed.
- **x**
  - an object for which a summary is to be printed.
- **digits**
  - a non-null value is used to indicate the number of significant digits. If `digits` is `NULL` then the value of digits specified by `options` is used.
- **horizons**
  - optional integer vector indicating horizons at which the summary should be calculated.
- **series**
  - The series which should be plotted. The default `NULL` gives all series.
- **...**
  - arguments passed to other methods.

See Also

- `summary print`
Summary.TSdata

Specific Methods for Summary

Description

See the generic function description.

Usage

```r
## S3 method for class 'TSdata'
summary(object, ...)
## S3 method for class 'SS'
summary(object, ...)
## S3 method for class 'ARMA'
summary(object, ...)
## S3 method for class 'TSestModel'
summary(object, ...)
## S3 method for class 'summary.TSdata'
print(x, digits=options()$digits, ...)
## S3 method for class 'summary.SS'
print(x, digits=options()$digits, ...)
## S3 method for class 'summary.ARMA'
print(x, digits=options()$digits, ...)
## S3 method for class 'summary.TSestModel'
print(x, digits=options()$digits, ...)
```

Arguments

- `object` an object to be summarized.
- `x` a summary object to be printed.
- `digits` number of significant digits to use for printing.
- `...` arguments passed to other methods.

See Also

`print`, `summary`
sumSqerror

Calculate sum of squared prediction errors

Description

Calculate a weighted sum squared prediction errors for a parameterization.

Usage

sumSqerror(coefficients, model=NULL, data=NULL, error.weights=NULL)

Arguments

coefficients  A vector of coefficients (parameters).
model  an object of class TSmodel which gives the structure of the model for which coefficients are used. coef(model) should be the same length as coefficients.
data  an object of class TSdata which gives the data with which the model is to be evaluated.
error.weights  a vector of weights to be applied to the squared prediction errors.

Details

This function is primarily for use in parameter optimization, which requires that an objective function be specified by a vector of parameters. It returns only the sum of the weighted squared errors (eg. for optimization). The sample size is determined by TobsOutput(data).

Value

The value of the sum squared errors for a prediction horizon given by the length of error.weights. Each period ahead is weighted by the corresponding weight in error.weights.

See Also

l.SS.l.ARMA

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
sumSqerror(1e-10 + coef(model), model=TSmodel(model),
    data=TSdata(model), error.weights=c(1,1,10))
Specific Methods for Testing Equality

Description

See the generic function description.

Usage

```r
## S3 method for class 'ARMA'
testEqual(obj1, obj2, fuzz=0)
## S3 method for class 'SS'
testEqual(obj1, obj2, fuzz=0)
## S3 method for class 'TSdata'
testEqual(obj1, obj2, fuzz=1e-16)
## S3 method for class 'TSmodel'
testEqual(obj1, obj2, fuzz=0)
## S3 method for class 'TSestModel'
testEqual(obj1, obj2, fuzz=0)
```

Arguments

- `obj1`: see generic method.
- `obj2`: see generic method.
- `fuzz`: see generic method.

See Also

testEqual
Usage

```r
## S3 method for class 'forecast'
testEqual(obj1, obj2, fuzz=1e-14)
## S3 method for class 'forecastCov'
testEqual(obj1, obj2, fuzz=1e-14)
## S3 method for class 'horizonForecasts'
testEqual(obj1, obj2, fuzz=1e-14)
## S3 method for class 'estimatedModels'
testEqual(obj1, obj2, fuzz = 0)
```

Arguments

- `obj1`: an object which is to be compared with the second object.
- `obj2`: an object which is to be compared with the first object.
- `fuzz`: tolerance for numerical comparisons. Values within `fuzz` will be considered equal.

See Also

- `testEqual`

Description

See the generic function description.

Usage

```r
## S3 method for class 'forecast'
tfplot(x, tf=NULL, start=tfstart(tf), end=tfend(tf),
       series = seq(length=nseriesOutput(x$data)),
       Title="Predictions (dotted) and actual data (solid)",
       ylab = seriesNamesOutput(x$data),
       graphs.per.page=5, mar=par()$mar, reset.screen=TRUE, ...)
```

## S3 method for class 'horizonForecasts'
tfplot(x, tf=NULL, start=tfstart(tf), end=tfend(tf),
       series=seq(length=nseriesOutput(x$data)),
       Title="Predictions (dotted) and actual data (solid)",
       ylab=seriesNamesOutput(x$data),
       graphs.per.page=5, mar=par()$mar, reset.screen=TRUE, ...)

## S3 method for class 'estimatedModels'
tfplot(x, tf=NULL, start=tfstart(tf), end=tfend(tf),
       series=seq(length=nseriesOutput(x$data)),
       Title="Predictions (dotted) and actual data (solid)",
       ylab=seriesNamesOutput(x$data),
       graphs.per.page=5, mar=par()$mar, reset.screen=TRUE, ...)
```
**Arguments**

- **x**: an object for which a tfplot is to be produced.
- **tf**: see tfplot.
- **start**: see tfplot.
- **end**: see tfplot.
- **Title**: string of characters to use for title.
- **ylab**: vector of strings for y axis labelling.
- **graphs.per.page**: integer indicating number of graphs to place on a page.
- **reset.screen**: logical indicating if the plot window should be cleared before starting.
- **series**: integer or string indicating the series which should be plotted.
- **mar**: plot margins. See par.
- **...**: arguments passed to other methods.

**See Also**

tfplot EstEval

tfplot.forecastCov

**Description**

Generate plots of forecast variance calculated by forecastCov.

**Usage**

```r
## S3 method for class 'forecastCov'

tfplot(x, ...,
series = 1:dim(x$forecastCov[[1]])[2],
select.cov = 1:length(x$forecastCov), select.true = TRUE,
select.zero = TRUE, select.trend = TRUE, y.limit = NULL, line.labels = FALSE,
lty = NULL, Legend = NULL, Title = NULL,
graphs.per.page = 5, mar = par()$mar, reset.screen = TRUE)
## S3 method for class 'forecastCovEstimatorsWRTdata'

tfplot(x,
series = 1:dim(x$forecastCov[[1]])[2],
select.cov = 1:length(x$forecastCov),
select.zero = TRUE, select.trend = TRUE,
graphs.per.page = 5, mar = par()$mar, reset.screen = TRUE, lty = NULL, ...)
```
Arguments

- **x**: The result of `forecastCov`.
- **series**: integer or string indicating the series which should be plotted.
- **select.cov**: logical indicating that for the case of multiple models select the covariance to be plotted.
- **select.true**: logical indicating that results from the forecast of the true model (if available) should be plotted.
- **select.zero**: logical indicating that results from a forecast of zero should be plotted.
- **select.trend**: logical indicating that results from a forecast of trend should be plotted.
- **graphs.per.page**: The number of graphs to put on a page.
- **mar**: plot margins (see `par`).
- **reset.screen**: logical indicating if the plot window should be cleared before starting.
- **lty**: see details.

Legend

- **optional legend** passed to `legend`.
- **Title**: optional legend passed to `title` (but see details).
- **y.limit**: optional limit on the y scale. Covariance values larger than `y.limit` will not be shown.
- **line.labels**: logical indicating line labels should be printed.
- **...**: For `forecastCov` objects this allows additional objects to be plotted. For `forecastCovEstimatorsWRTdata` ... are passed to other methods.

Details

This function produces plots of the variance at different horizons. Output graphics can be paused between pages by setting `par(ask=TRUE)`. If `lty` is NULL (default) it is set to `seq(length(select.cov) + select.true + select.zero + select.trend)`, and corrected if these are TRUE but not in the object.

The Title is not put on the plot if the global option PlotTitles is FALSE. This can be set with `options(PlotTitles=FALSE)`. This provides a convenient mechanism to omit all titles when the title may be added separately (e.g. in Latex).

Value

*None*

See Also

- `plot`

Examples

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
z <- forecastCov(model, data=eg1.DSE.data.diff)
tfplot(z)
```
### S3 method for class 'TSdata'

```r
tfplot(x, ...,
      tf=NULL, start=tfstart(tf), end=tfend(tf),
      select.inputs = seq(length=nseriesInput(x)),
      select.outputs = seq(length=nseriesOutput(x)),
      Title=NULL, xlab=NULL, ylab=NULL,
      graphs.per.page=5, mar=par()$mar, reset.screen=TRUE)
```

### S3 method for class 'TSestModel'

```r
tfplot(x, ...,
      tf=NULL, start=tfstart(tf), end=tfend(tf),
      select.inputs=NULL, select.outputs=NULL,
      Title=NULL, xlab=NULL, ylab=NULL,
      graphs.per.page=5, mar=par()$mar, reset.screen=TRUE)
```

### Arguments

- `x` object to be plotted.
- `...` additional objects to be plotted.
- `start` start of plot.
- `end` end of plot.
- `tf` an alternate way to specify start and end of plot.
- `select.inputs` series to be plotted. (passed to selectSeries)
- `select.outputs` series to be plotted. (passed to selectSeries)
- `Title` string to use for plot title (passed to plot - see tfplot).
- `xlab` string to use for x label (passed to plot).
- `ylab` string to use for y label (passed to plot).
- `graphs.per.page` integer indicating number of graphs to place on a page.
- `mar` margins passed to plot. See par.)
- `reset.screen` logical indicating if the plot window should be cleared before starting. If this is not TRUE then mar values will have no effect.

### See Also

- `tfplot`
Specific Methods for tframed Data

Description

See the generic function description.

Usage

```r
## S3 method for class 'TSdata'
tframed(x, tf=NULL, names=NULL, ...)  
## S3 replacement method for class 'TSdata'
tframe(x) <- value  
## S3 method for class 'TSdata'
tfwindow(x, tf=NULL, start=tfstart(tf), end=tfend(tf), warn=TRUE)  
## S3 method for class 'TSdata'
tbind(x, d2, ..., pad.start=TRUE, pad.end=TRUE, warn=TRUE)  
## S3 method for class 'TSdata'
trimNA(x, startNAs=TRUE, endNAs=TRUE)  
## S3 method for class 'TSdata'
window(x, start=NULL, end=NULL, tf=NULL, warn=TRUE, ...)  
```

Arguments

- `x` See the generic function.
- `tf` a time frame. See the generic function.
- `value` a time frame to associate with `x`.
- `names` A list with elements `input` and `output` which are strings passed as names to the default method.
- `start` See the generic function.
- `startNAs` See the generic function.
- `end` See the generic function.
- `endNAs` See the generic function.
- `d2` See the generic function.
- `pad.start` See the generic function.
- `pad.end` See the generic function.
- `warn` logical indicating if some warning messages should be suppressed.
- `...` arguments passed to other functions.

Details

The generic function is applied to input and to output data.

See Also

tframed, tfwindow, tbind, trimNA
toARMA  
*Convert to an ARMA Model*

**Description**
Convert a state space model to an ARMA representation. The state is eliminated by a method which uses an equivalence that can be demonstrated by the Cayley Hamilton theorem. It is not very parsimonious.

**Usage**

```r
## S3 method for class 'ARMA'
toARMA(model, ...)
## S3 method for class 'SS'
toARMA(model, fuzz=1e-10, ...)
## S3 method for class 'TSestModel'
toARMA(model, ...)
```

**Arguments**
- `model` : An object of class TSmodel.
- `fuzz` : Parameters closer than fuzz to one or zero are set to 1.0 or 0.0 respectively
- `...` : arguments to be passed to other methods.

**Value**
An object of class 'ARMA' 'TSmodel' containing an ARMA model.

**References**

**See Also**
toSS fixConstants

**Examples**
```r
data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARXls(eg1.DSE.data.diff))
model <- toARMA(model)
```
Description

See the generic function description.

Usage

```r
## S3 method for class 'TSdata'
Tobs(x, ...)

## S3 method for class 'TSestModel'
Tobs(x)

## S3 method for class 'TSdata'
start(x, ...)

## S3 method for class 'TSestModel'
start(x, ...)

## S3 method for class 'TSdata'
end(x, ...)

## S3 method for class 'TSestModel'
end(x, ...)

## S3 method for class 'TSdata'
frequency(x, ...)

## S3 method for class 'TSestModel'
frequency(x, ...)
```

Arguments

- `x` a time series object.
- `...` (further arguments, currently disregarded).

See Also

- `Tobs, tfstart, tfend, tffrequency start, end, frequency`

Description

Apply a method to the input or output data.
Usage

TobsInput(x)
## S3 method for class 'TSdata'
TobsInput(x)
## S3 method for class 'TSeestModel'
TobsInput(x)

TobsOutput(x)
## S3 method for class 'TSdata'
TobsOutput(x)
## S3 method for class 'TSeestModel'
TobsOutput(x)

startInput(x)
## S3 method for class 'TSdata'
startInput(x)
## S3 method for class 'TSeestModel'
startInput(x)

startOutput(x)
## S3 method for class 'TSdata'
startOutput(x)
## S3 method for class 'TSeestModel'
startOutput(x)

endInput(x)
## S3 method for class 'TSdata'
endInput(x)
## S3 method for class 'TSeestModel'
endInput(x)

endOutput(x)
## S3 method for class 'TSdata'
endOutput(x)
## S3 method for class 'TSeestModel'
endOutput(x)

frequencyInput(x)
## S3 method for class 'TSdata'
frequencyInput(x)
## S3 method for class 'TSeestModel'
frequencyInput(x)

frequencyOutput(x)
## S3 method for class 'TSdata'
frequencyOutput(x)
## S3 method for class 'TSeestModel'
frequencyOutput(x)
Arguments

\( x \)  
An object containing TSdata.

Details

Apply a method to the input or output data so, for example, \( \text{TobsInput}(x) \) in theory does \( \text{Tobs}(\text{inputData}(x)) \), which returns the number of observation periods in input data. The actual implementation may not do \( \text{Tobs}(\text{inputData}(x)) \). For example, with TSPADIdata \( \text{inputData}(x) \) requires a database retrieval which may be fairly slow, while the number of periods may be available much more quickly.

Value

Depends.

Examples

```r
data("eg1.DSE.data.diff", package="dse")
\text{TobsOutput}(\text{eg1.DSE.data.diff})
```

---

toSS  

Convert to State Space Model

Description

Convert a model to state space form.

Usage

```r
toSS(model, ...)  
## S3 method for class 'ARMA'
toSS(model, ...)  
## S3 method for class 'SS'
toSS(model, ...)  
## S3 method for class 'TSestModel'
toSS(model, ...)  
toSSaugment(model, ...)  
## S3 method for class 'ARMA'
toSSaugment(model, fuzz=\text{1e-14}, ...)  
## S3 method for class 'TSestModel'
toSSaugment(model, ...)  
toSSnested(model, ...)  
## S3 method for class 'ARMA'
toSSnested(model, n=\text{NULL}, Aoki=\text{FALSE}, ...)  
```
## S3 method for class 'SS'
toSSnested(model, n=NULL, Aoki=FALSE, ...)
## S3 method for class 'TSestModel'
toSSnested(model, ...)

### Arguments

- **model**
  - An object of class TSmodel.

- **n**
  - If n is specified then it is used as the state dimension when the markov parameter conversion technique is required.

- **Aoki**
  - logical indicating if Aoki’s method (which does not work in general) should be tried.

- **fuzz**
  - if the zero lag term of polynomials A and B are within fuzz of the identity matrix then they are not inverted. (i.e. they are assumed to be identity.)

- **...**
  - arguments to be passed to other methods.

### Details

If the order of the AR polynomial equals or exceeds the MA polynomial (and the input polynomial) then the model is converted by state augmentation. Otherwise, it is converted by approximating the markov coefficients a la Mittnik. (This may not always work very well. Compare the results to check.)

### Value

A state space model in an object of class 'SS' 'TSmodel'.

### Examples

```r
data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
model <- toSS(model)
```

---

## toSSChol

_Convert to Non-Innovation State Space Model_

### Description

This function may not be working properly.

Convert to a non-innovations state space representation using the given matrix (Om) as the measurement noise covariance. Om would typically be an estimate of the output noise, such as returned in estimates$cov of the function 1 (1.SS or 1.ARMA). This assumes that the noise processes in the arbitrary SS representation are white and uncorrelated.
### toSSinnov

#### Usage

```r
toSSChol(model, ...)  
## S3 method for class 'TSmodel'  
toSSChol(model, Om=diag(1,nseriesOutput(model)), ...)  
## S3 method for class 'TSestModel'  
toSSChol(model, Om=NULL, ...)```

#### Arguments

- `model`: An object of class TSmodel.
- `Om`: a matrix to be used as the measurement noise covariance. If Om is not supplied and model is of class TSestModel then `model$estimates$cov` is used. Otherwise, Om is set to the identity matrix.
- `...`: arguments to be passed to other methods.

#### Details

Convert to a non-innovations SS representation using a Cholesky decomposition of Om as the coefficient matrix of the output noise.

#### Value

An object of class 'SS' 'TSmodel' containing a state space model which is not in innovations form.

#### See Also

- `toSSinnov`

#### Examples

```r
data("eg1.DSE.data.diff", package="dse")  
model <- estVARXls(eg1.DSE.data.diff)  
model <- toSSChol(model)
```

---

### toSSinnov

#### Convert to State Space Innovations Model

#### Description

Convert to a state space innovations representation.

#### Usage

```r
toSSinnov(model, ...)```
Arguments

model an object of class TSmodel.

Value

If the argument is a TSmodel then the result is an object of class 'SS' 'TSmodel' If the argument is a TSestModel then the converted model is evaluated with the data an a TSestModel is returned. The TSmodel is an innovations state space representation.

This assumes that the noise processes in the arbitrary SS representation are white and uncorrelated.

See Also
toSS, toSSOform toSSChol

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)
model <- toSSinnov(model)
summary(model)

model2 <- SS(F=diag(1,3), H=matrix(c(1,0,0,1,0,0),2,3),
Q=diag(0.5, 3, 3), R=diag(1.1, 2,2),
description="test model", output.names=c("output 1", "output 2"))
model2 <- toSSinnov(model2)
summary(model2)
totalForecastCov

Details

WARNING: This function does not work properly.

Convert to a SS innovations representation with a minimum number of parameters by converting as much of H as possible to I matrix. Any remaining reductions are done by converting part of ?? to I. It seems there should remain n(m+2p) free parameters in F,G,H,K, and Om is determined implicitly by the residual.

Value

An object of class 'SS' 'TSmodel' containing a state space model in observability form (more or less).

See Also

toSSinnov

Examples

data("eg1.DSE.data.diff", package="dse")
model <- estVARXls(eg1.DSE.data.diff)

---

totalForecastCov Sum covariance of forecasts across all series

Description

Sum covariance of forecasts across all series.

Usage

totalForecastCov(obj, select=NULL)

Arguments

obj An object as returned by forecastCov.
select Series to be select for summation. With the default all series are selected.

Value

An object similar to that returned by forecastCov, with the covariance summed over all selected series.
Examples

```r
data(‘eg1.DSE.data.diff’, package=’dse’)
model1 <- estVARXar(eg1.DSE.data.diff)
model2 <- estVARXls(eg1.DSE.data.diff)
z <- totalForecastCov(forecastCov(model1, model2,
                           data=trimNA(eg1.DSE.data.diff)))
```

---

**TSdata**

Construct TSdata time series object

---

**Description**

Constructor for constructing or extracting a TSdata object (use by TSmodels).

**Usage**

```r
TSdata(data=NULL, ...)
## Default S3 method:
TSdata(data=NULL, input=NULL, output=NULL, ...)
## S3 method for class 'TSdata'
TSdata(data, ...)
## S3 method for class 'TSestModel'
TSdata(data, ...)
  is.TSdata(obj)
  as.TSdata(d)
```

**Arguments**

- **data**
  - object of class TSdata, TSestModel, matrix, list with input and output matrices, or another object for which a constructor or TSdata extraction method has been defined.
- **input**
  - a matrix of time series data.
- **output**
  - a matrix of time series data.
- **...**
  - arguments to be passed to other methods.
- **obj**
  - an object.
- **d**
  - an object from which a TSdata object can be extracted. See below.

**Details**

Generic method to construct or extract a TSdata object. The default method constructs a TSdata object. Specific methods extract the TSdata from other objects (which must contain TSdata). The function `is.TSdata(data)` returns TRUE if data inherits from TSdata and FALSE otherwise.

The function `as.TSdata` uses the elements input and output directly and strips away other class information and parts of the object (and does not make use of `inputData(data)` or `outputData(data)` which may do something special for certain classes.
TSdata.forecastCov

See Also

TSdata.object, TSmodel, TEstModel.object

Examples

```r
rain <- matrix(rnorm(86*17), 86,17)
radar <- matrix(rnorm(86*5), 86,5)
mydata <- TSdata(input=radar, output=rain)
```

TSdata.forecastCov  TS Extractor Specific Methods

Description

See the generic function description.

Usage

```r
## S3 method for class 'forecastCov'
TSdata(data, ...)
## S3 method for class 'forecastCov'
TSmodel(obj, select=1, ...)
```

Arguments

- `data`: an object from which to extract the TSdata.
- `obj`: an object from which to extract the TSmodel or TEstModel.
- `select`: an integer indicating which of multiple models to extract.
- `...`: arguments to be passed to other methods.

See Also

TSdata TEstModel TSmodel
**TSdata.object**  
*time series data object*

**Description**  
Class `TSdata` of time series data objects for use with `TSmodels`.

**Generation**  
This class of objects is returned by specific methods of the function `TSdata` or can be built according to the description below.

**Methods**  
The `TSdata` class of objects has methods for the generic functions `print`, `plot`, `start`, `end`, `...`, `testEqual`, `seriesNames`, `seriesNamesInput`, `seriesNamesOutput` Also, the function `is.TSdata` is supported.

**Inheritance**  
Other data classes inherit from the class `TSdata`.

**Structure**  
Objects are a list with class the most general class `TSdata`. The native form for this package has elements `input` and `output`. Any other elements are ignored. `input` and `output` are matrices (or `tframe` or time series matrices) of the input and output data, with each series in a column. It is possible to populate this structure directly from a time series database. See the `TSdbi` package for more details.

**See Also**  
`TSdata`, `TSmodel`, `TSestModel.object`

---

**TSestModel**  
*Estimated Time Series Model*

**Description**  
Object containing a time series model, data, and estimation information.

**Usage**  
```r
TSestModel(obj)  
# S3 method for class 'TSestModel'
TSestModel(obj)  
is.TSestModel(obj)
```
Arguments

obj in the first usage an object from which a TSestModel object can be extracted (or constructed).

Details

The TSestModel class of objects are generated by estimation methods. See, for example, estVARXls. They contains a time series model (TSmodel), data (TSdata), and information obtained by evaluating the model with the data in an element called estimates containing:

- **like** The negative log likelihood function value (a vector of the total, constant, the det part, and the cov part)
- **cov** The estimated residual covariance.
- **pred** The one step ahead predictions (see predictT below). These are aligned with output data so that residuals are pred[1:samplenT,] - output[1:samplenT,]
- **samplenT** The end of the period (starting from 1) for which output is used for calculating one step ahead predictions.
- **predictnT** The end of the period for which the model is simulated. samplenT must be less than or equal predictnT. If predictT is greater than samplenT then each step ahead beyond samplenT is based on the prediction of the previous step and not corrected by the prediction error.
- The element estimates may optionally also contain and element filter which may have
  - **state** The one step ahead (filter) estimate of the state E[z(t)|y(t-1), u(t)]. Note: In the case where there is no input u this corresponds to what would usually be called the predicted state - not the filtered state.
  - **track** The estimated state tracking error P(t|t-1). Again note, this corresponds to the predicted tracking error not the filtered tracking error. This is NULL for innovations models.
- **smooth** a list of:
  - **state** The smoother (two sided filter) estimate of the state E[z(t)|samplenT].
  - **track** The smoothed estimate of the state tracking error P(t|samplenT). This is NULL for innovations models.

See Also

estVARXls, TSmodel, TSdata

---

**TSmodel**

**Time Series Models**

Description

Construct or extract a “TSmodel” from objects.
Usage

TSmodel(obj, ...)
  ## S3 method for class 'TSmodel'
TSmodel(obj, ...)
  ## S3 method for class 'TSestModel'
TSmodel(obj, ...)
  is.TSmodel(obj)

Arguments

obj       An object containing an object of class TSmodel or a list containing the information necessary to build an object of class TSmodel.
...

...       arguments passed to other methods.

Details

This is a generic method which will extract a TSmodel from an object (e.g., a TSestModel). The default method will try to build an ARMA or state-space TSmodel from a list, which must contain the necessary information.

This class of objects is returned by estimation methods or can be built according to the description for specific sub-classes (e.g., ARMA, SS).

The TSmodel class of objects has methods for the generic functions print, testEqual, seriesNames, seriesNamesInput, seriesNamesOutput, l, roots, stability, forecast, featherForecasts, horizonForecasts, simulate, MonteCarloSimulations

Also, the function is.TSmodel and the functions toSS, toARMA, to.troll are supported. Other model classes inherit from the class TSmodel.

This class of objects contains a time series model. It is the class of objects expected by many of the functions in this package.

Sub-class (e.g., ARMA and SS for linear, time-invariant ARMA and state space models) are documented individually. Many of the functions in this package are designed for estimating and converting among various representations of these types of models.

See Also

ARMA, SS, TSestModel, TSdata
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