

Package ‘dse’

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Title Dynamic Systems Estimation (time series package)

Description Package dse provides tools for multivariate, linear, time-invariant, time series models. It 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), tframe (>= 2007.5-3), setRNG (>= 2004.4-1)

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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

- Anderson, B. D. O. and Moore, J. B. (1979) *Optimal Filtering*. Prentice-Hall.
- Gilbert, P. D. (1993) State space and ARMA models: An overview of the equivalence. Working paper 93-4, Bank of Canada. Available at <http://www.bankofcanada.ca/1993/03/publications/research/working-paper-199/>
- Gilbert, P. D. (1995) Combining VAR Estimation and State Space Model Reduction for Simple Good Predictions. *J. of Forecasting: Special Issue on VAR Modelling*. **14**:229–250.
- Gilbert, P.D. (2000) A note on the computation of time series model roots. *Applied Economics Letters*, **7**, 423–424
- Jazwinski, A. H. (1970) *Stochastic Processes and Filtering Theory*. Academic Press.

See Also

[TSdata](#), [TModel](#), [TSestModel](#).object

00.dse.Intro

Dynamic Systems Estimation - Multivariate Time Series Package

Description

Functions for multivariate time series modeling

Details

See [dse-package](#) (in the help system use `package?dse` or `?dse-package`) for an overview.

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 <- estVARX1s(eg1.DSE.data.diff)
plot(roots(model))
addPlotRoots(toSS(model))
```

 ARMA

ARMA Model Constructor

Description

Constructs an ARMA TSmodel object as used by the DSE package.

Usage

```
ARMA(A=NULL, B=NULL, C=NULL, TREND=NULL,
      constants=NULL,
      description=NULL, names=NULL, input.names=NULL, output.names=NULL)
is.ARMA(obj)
```

Arguments

A	The auto-regressive polynomial, an $a \times p$ array.
B	The moving-average polynomial, an $b \times p$ array.
C	The input polynomial, an $c \times p$ array. C should be NULL if there is no input
TREND	A matrix, p-vector, or NULL.

Value

A state space model in a TSestModel object.

References

See references for [MittnikReduction](#).

See Also

[estVARXls](#), [estVARXar](#) [MittnikReduction](#)

Examples

```
data("eg1.DSE.data.diff", package="dse")
model <- toSS(TSmodel(estVARXls(eg1.DSE.data.diff)))
## Not run: newmodel <-balanceMittnik(model)
# this prints information about singular values and prompts with
#Enter the number of singular values to use for balanced model:
# 18 might be a good choice in this example.
newmodel <-balanceMittnik(model, n=18)
```

bestTSestModel	<i>Select Best Model</i>
----------------	--------------------------

Description

Select the best model.

Usage

```
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 <code>informationTestsCalculations</code> . 'taic' would be a better default but this is not available for VAR and ARMA models.
verbose	if TRUE then additional information is printed.

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)
```

checkBalance

Check Balance of a TSmodel

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.

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.

Side Effects

Differences between the observability and reachability gramians are printed.

See Also

[checkBalanceMittnikReduction](#)

Examples

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

```
checkConsistentDimensions
```

Check Consistent Dimensions

Description

Check that dimensions of a model and data agree.

Usage

```
checkConsistentDimensions(obj1, obj2=NULL)
## Default S3 method:
checkConsistentDimensions(obj1, obj2=NULL)
## S3 method for class 'ARMA'
checkConsistentDimensions(obj1, obj2=NULL)
## S3 method for class 'SS'
checkConsistentDimensions(obj1, obj2=NULL)
## S3 method for class 'TSdata'
checkConsistentDimensions(obj1, obj2=NULL)
## S3 method for class 'TSestModel'
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.

Value

logical

Examples

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

checkResiduals	<i>Autocorrelations Diagnostics</i>
----------------	-------------------------------------

Description

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

Usage

```
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)
```

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

object	An object of class TSmodel or TSestModel.
value	value to be assigned to object.
...	(further arguments, currently disregarded).

Value

A vector of parameter values.

Examples

```
data("eg1.DSE.data.diff", package="dse")
model <- estVARX1s(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

```
## 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](#) [forecastCov](#)

Examples

```
#z <- combine(obj1, obj2)
```

combine.TSdata *Combine series from two TSdata objects.*

Description

Combine series from two TSdata objects.

Usage

```
## 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

```
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

```
.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 not 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()$COMPILED` returns FALSE. `.DSEflags()$DUP` is passed to fortran calls and controls whether R duplicates arguments passed to the fortran code. The safe setting is TRUE. Setting FALSE saves some memory but does not seem to give much speed gain.

Side Effects

The flag settings affect whether and how compiled fortran or C code is called.

Examples

```
.DSEflags(list(COMPILED=TRUE, DUP=TRUE))
.DSEflags()$COMPILED
```

DSEversion

Print Version Information

Description

Print version information.

Usage

```
DSEversion()
```

Examples

```
DSEversion()
```

eg1.DSE.data

Four Time Series used in Gilbert (1993)

Description

Data is for Canada. The series start in March 1961 (April 1961 for `eg1.DSE.data.diff`) and end in June 1991, giving 364 observations on each variable (363 for `eg1.DSE.data.diff`).

The input series is 90-day interest rates (R90) in both `eg1.DSE.data` and `eg1.DSE.data.diff`.

The output series are M1, GDP lagged two months, and CPI. M1, GDP and CPI were all seasonally adjusted data. These are not transformed in `eg1.DSE.data` and are first difference of logs in `eg1.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.)

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

Gilbert, P.D. 1995 "Combining VAR Estimation and State Space Model Reduction for Simple Good Predictions" *J. of Forecasting: Special Issue on VAR Modelling*. 14:229-250

See Also

[TSdata](#)

estBlackBox

Estimate a TSmodel

Description

Estimate a TSmodel.

Usage

```
estBlackBox(data,...)
```

Arguments

data	Data in an object of class TSdata.
...	Optional arguments depend on the function which is eventually called.

Details

The function makes a call the most promising procedure currently available. These tend to have names like estBlackBox1, estBlackBox2, estBlackBox4. This is an active area of ongoing research and so the actual routine called will probably change with new versions.

Value

A state space model in an object of class TSestModel.

Examples

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

 estBlackBox1

Estimate a TSmodel

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.

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='estVAR1s',
             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

Gilbert, P.D. (1995) Combining VAR Estimation and State Space Model Reduction for Simple Good Predictions *J. of Forecasting: Special Issue on VAR Modelling*, **14**, 229–250.

See Also

[estBlackBox1](#), [estBlackBox3](#) [estBlackBox4](#) [informationTestsCalculations](#)

Examples

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

estBlackBox3	<i>Estimate a TSmodel</i>
--------------	---------------------------

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 . taic 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, ... )
```

estimateModels	<i>Estimate Models</i>
----------------	------------------------

Description

Estimate models using given estimation method

Usage

```
estimateModels(data, estimation.sample = NULL, trend =FALSE, quiet =FALSE,
               estimation.methods = NULL)
is.estimatedModels(obj)
```

Arguments

<code>data</code>	An object of class TSdata.
<code>estimation.methods</code>	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.
<code>estimation.sample</code>	An integer indicating the number of points in the sample to use for estimation. If it is NULL the whole sample is used.
<code>trend</code>	If trend is TRUE then a linear trend is calculated and returned as the element <code>trend.coef</code> .
<code>quiet</code>	If quiet is TRUE then most printing and some warning messages are suppressed.
<code>obj</code>	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.forecastCovEstimatorsSWRTdata](#)

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)))
```

 estMaxLik

Maximum Likelihood Estimation

Description

Maximum likelihood estimation.

Usage

```

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.

Details

This function uses the functions estVARXls and toSS.

Value

A state space model in an object of class TSestModel.

References

Gilbert, P. D. (1993) State space and ARMA models: An overview of the equivalence. Working paper 93-4, Bank of Canada. Available at <http://www.bankofcanada.ca/1993/03/publications/research/working-paper-199/>.

Gilbert, P. D. (1995) Combining VAR Estimation and State Space Model Reduction for Simple Good Predictions. *J. of Forecasting: Special Issue on VAR Modelling*. 14:229-250.

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")
## Not run: model <- estSSMittnik(egJoff.1dec93.data)
# this prints information about singular values and prompts with
#Enter the number of singular values to use for balanced model:
# the choice is difficult in this example.
model <- estSSMittnik(egJoff.1dec93.data, n=3)
```

 estVARXar

Estimate a VAR TSmodel

Description

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

Usage

```
estVARXar(data, subtract.means=FALSE, re.add.means=TRUE, standardize=FALSE,
  unstandardize=TRUE, aic=TRUE, max.lag=NULL, method="yule-walker", warn=TRUE)
```


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

Gilbert, P. D. (1993) State space and ARMA models: An overview of the equivalence. Working paper 93-4, Bank of Canada. Available at <http://www.bankofcanada.ca/1993/03/publications/research/working-paper-199/>

Gilbert, P. D. (1995) Combining VAR Estimation and State Space Model Reduction for Simple Good Predictions. *J. of Forecasting: Special Issue on VAR Modelling*. **14**:229–250.

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

[estVAR1s](#) [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

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

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](#)


```
F = matrix(c(TRUE, FALSE, FALSE, FALSE), 2,2))
ss
coef(ss)
data("eg1.DSE.data.diff", package="dse")
model <- toARMA(toSS(estVARX1s(eg1.DSE.data.diff)))
model <- 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

```
fixF(model)
```

Arguments

model An object of class TSmodel.

Value

An SS TSmodel object.

See Also

[fixConstants](#)

Examples

```
data("eg1.DSE.data.diff", package="dse")
model <- toSS(estVARX1s(eg1.DSE.data.diff))
model <- fixF(model)
```

forecast	<i>Forecast Multiple Steps Ahead</i>
----------	--------------------------------------

Description

Calculate forecasts multiple steps ahead.

Usage

```

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 indication 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


```

        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 TSmodels 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 TSmodel(obj) is used with data to produce a forecast. TSmodel() 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

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

forecastCovReductionsWRTtrue

Forecast covariance for different models

Description

Calculate the forecast covariance for different models.

Usage

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

Arguments

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

```

forecastCovWRTtrue(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.forecastCovWRTdata(obj)

```

Arguments

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

```

data("eg1.DSE.data.diff", package="dse")
true.model <- estVARXls(eg1.DSE.data.diff) # A starting model TSestModel
data <- simulate(true.model)
models <- list(TSmodel(estVARXar(data)), TSmodel(estVARXls(data)))
z <- forecastCovWRTtrue( models, true.model)

```

forecasts

*Extract Forecasts***Description**

Extract forecasts from an object.

Usage

```

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

```

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))
z <- forecasts(pr)

```

`gmap`*Basis Transformation of a Model.*

Description

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

Usage

```
gmap(g, model)
```

Arguments

<code>g</code>	An invertible matrix
<code>model</code>	An object of class <code>TSmodel</code> .

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(estVARX1s(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

```
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

<code>obj</code>	see <code>horizonForecasts</code> .
<code>data</code>	see <code>horizonForecasts</code> .
<code>horizons</code>	see <code>horizonForecasts</code> .
<code>discard.before</code>	see <code>horizonForecasts</code> .
<code>...</code>	see <code>horizonForecasts</code> .

Details

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

Value

See `horizonForecasts`.

See Also

[horizonForecasts](#)

Examples

```
data("eg1.DSE.data.diff", package="dse")  
model <- estVARX1s(eg1.DSE.data.diff)  
z <- horizonForecasts(model, eg1.DSE.data.diff)
```

informationTests	<i>Tabulates selection criteria</i>
------------------	-------------------------------------

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

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

Arguments

lst	One or more objects of class TEstModel.
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 preceding '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

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

inputData	<i>TSdata Series</i>
-----------	----------------------

Description

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

Usage

```

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

```

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 can be generated in different ways but the only current example is `stripMine`.

Value

logical

See Also

[stripMine](#)

1 *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, ...)
```

Arguments

obj1 a TSmodel, TSdata, or TSestModel object.
 obj2 a TSmodel or TSdata object.
 ... arguments to be passed to other methods.

Details

For state space models `l.SS` is called and for ARMA models `l.ARMA` is called.

Value

Usually a `TSestModel` object is returned. Most methods allow an argument `result` which specifies that a certain part of the object is returned. (This is passed in `...` to another method in most cases.) The likelihood can be returned by specifying `result="like"`, which is useful for optimization routines.

See Also

[l.SS](#), [l.ARMA](#)

Examples

```
data("eg1.DSE.data.diff", package="dse")
model <- toSS(TSmodel(estVARX1s(eg1.DSE.data.diff)))
evaluated.model <- l(model, eg1.DSE.data.diff)
```

`l.ARMA`

Evaluate an ARMA TSmodel

Description

Evaluate an ARMA TSmodel.

Usage

```
## S3 method for class 'ARMA'
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.

<code>result</code>	if non-NULL then the returned value is only the sub-element indicated by <code>result</code> . <code>result</code> can be a character string or integer.
<code>error.weights</code>	a vector of weights to be applied to the squared prediction errors.
<code>compiled</code>	indicates if a call should be made to the compiled code for computation. A FALSE value is mainly for testing purposes.
<code>warn</code>	if FALSE then certain warning messages are turned off.
<code>return.debug.info</code>	logical indicating if additional debugging information should be returned.
<code>...</code>	(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 1](#), [1.SS TSmmodel](#) [TSestModel.object](#)

Examples

```
data("eg1.DSE.data.diff", package="dse")
model <- TSmmodel(estVARX1s(eg1.DSE.data.diff))
evaluated.model <- l(model, eg1.DSE.data.diff)
```

1.SS

*Evaluate a state space TSmodel***Description**

Evaluate a state space TSmodel.

Usage

```
## S3 method for class 'SS'
l(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 <code>filter\$state</code> 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 <code>filter\$track</code> 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 <code>TSestModel</code> is returned. Otherwise, the specified element of <code>TSestModel\$estimates</code> 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).


```
summary(lmodel)
tfplot(lmodel)
lmodel <- l(model, eg1.DSE.data.diff, return.state=TRUE)
tfplot(state(lmodel, filter=TRUE))
```

markovParms

Markov Parameters

Description

Construct a Matrix of the Markov Parameters

Usage

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

Arguments

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

Details

Construct a matrix with partitions $[M_0 | \dots | M_i]$ 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

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

`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

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

nstates	<i>State Dimension of a State Space Model</i>
---------	---

Description

Extract the state dimension of a state space model object.

Usage

```
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	<i>Calculate Model Observability Matrix</i>
---------------	---

Description

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

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	<i>Calculate Portmanteau statistic</i>
-------------	--

Description

Calculate Portmanteau statistic.

Usage

```
Portmanteau(res)
```

Arguments

res A matrix with time-series residuals in columns.

See Also

[informationTests](#)

Examples

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

print.forecastCov	<i>Print Specific Methods</i>
-------------------	-------------------------------

Description

See the generic function description.

Usage

```
## 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).

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.

See Also[roots stability EstEval](#)

`scale.TSdata`*Scale Methods for TS objects*

Description

Scale data or a model by a given factor.

Usage

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

Arguments

<code>x</code>	TSdata, TSmodel or an object containing these.
<code>center</code>	to match generic arguments, not currently used.
<code>scale</code>	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. <code>scale\$input</code> 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. ie. 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))` will 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

<code>obj</code>	an object as returned by <code>stripMine</code> .
<code>series</code>	an indication of series to which the tests should be applied.
<code>select.cov.best</code>	the number of 'best' forecasts to select.
<code>select.cov.bound</code>	a bound to use as criteria for selection.
<code>ranked.on.cov.bound</code>	see details.
<code>verbose</code>	if <code>verbose=TRUE</code> 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` is used if it is not NULL and `select.cov.bound` is NULL. In this case `select.cov.best` is ignored. `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

[minForecastCov](#), [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=2000))
tfplot(selectForecastCov(z, select.cov.best=1))
```

`seriesNames.TSdata` *Series Names Specific Methods*

Description

See the generic function description.

Usage

```
## 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
```

Arguments

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.

See Also

[seriesNames](#)

seriesNamesInput	<i>TSdata Series Names</i>
------------------	----------------------------

Description

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

Usage

```
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

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

`seriesNamesInput.forecast`

TS Input and Output Specific Methods

Description

See the generic function description.

Usage

```
## 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

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

Arguments

<code>model</code>	An object of class TSmodel or TSestModel.
<code>horizon</code>	The number of periods for which to calculate the effect of shocks.
<code>shock</code>	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	<i>Simulate a TSmodel</i>
----------	---------------------------

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 y0[1,] and input0[1,] correspond to t=0. These arguments are not implemented for state space models. If not specified initial values are set to zero.
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 TSestModel, 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 `TSm`model, [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 $N(0, \text{sqr}(\text{sd}))$. `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 compatability 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](#), [TSM](#)odel, [TS](#)data, [ARMA](#), [SS](#)

Examples

```
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))
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, 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=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 TModel

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 'TModel'
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 informatin 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 arguement).

References

Anderson, B. D. O. and Moore, J. B. (1979) *Optimal Filtering*. Prentice-Hall.

Shumway R. H. and Stoffer D.S. (1982) An Approach to Time Series Smoothing and Forecasting Using the EM Algorithm. *J. of Time Series Analysis*, 3, 253–264 (note appendix).

Jazwinski, A. H. (1970) *Stochastic Processes and Filtering Theory*. Academic Press.

See Also

[state](#), [l](#), [SS](#), [l.SS](#) [TSmodel](#) [TSestModel](#). [object](#)

Examples

```
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

```
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.
z0	vector indicating estimate of the state at time 0. Set to zero if not supplied.
rootP0	matrix indicating a square root of the initial tracking error (e.g. chol(P0)).
P0	matrix indicating initial tracking error $P(t=1 t=0)$. Set to I if rootP0 or P0 are not supplied.
constants	NULL or a list of logical matrices with the same names as matrices above, indicating which elements should be considered constants.
description	String. An arbitrary description.
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 character strings indicating input variable names.
output.names	A vector of character strings indicating output variable names.
obj	an object.

Details

State space models have a further sub-class: *innov* or *non-innov*, indicating an innovations form or a non-innovations form.

The state space (SS) model is defined by:

$$z(t) = Fz(t-1) + Gu(t) + Qe(t)$$

$$y(t) = Hz(t) + R w(t)$$

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 would 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).

Typically, a 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

Anderson, B. D. O. and Moore, J. B. (1979) *Optimal Filtering*. Prentice-Hall. (note p.39,44.)

See Also

[TSmodel ARMA simulate.SS l.SS state smoother fixConstants](#)

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)
is.SS(ss)
ss
```

stability

Calculate Stability of a TSmodel

Description

Calculate roots and their modulus and indicate stability.

Usage

```
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

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

Details

`eps` prevents 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

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

state	<i>Extract State</i>
-------	----------------------

Description

Extract state information from estimated SS model.

Usage

```
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

<code>all.data</code>	An object of class <code>TSdata</code> .
<code>essential.data</code>	A vector indicating the important series.
<code>estimation.sample</code>	The portion of the data to use for estimation.
<code>discard.before</code>	Period before which data should be discarded when calculating the forecast covariances.
<code>horizons</code>	Forecast horizons which should be considered.
<code>quiet</code>	If T then estimation information is not printed. <code>quiet=TRUE</code> may also have to be set in the arguments to estimation methods.
<code>estimation.methods</code>	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.
<code>step.size</code>	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.forecastCov *Summary Specific Methods*

Description

See the generic function description.

Usage

```
## 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

```

    ## 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	<i>Calculate sum of squared prediction errors</i>
------------	---

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. <code>coef(model)</code> 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

[l1.SS1.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))
```

testEqual.ARMA	<i>Specific Methods for Testing Equality</i>
----------------	--

Description

See the generic function description.

Usage

```
## 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](#)

testEqual.forecast *Specific Methods for Testing Equality*

Description

See the generic function description.

Usage

```
## 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](#)

tfplot.forecast *Specific Methods for tfplot*

Description

See the generic function description.

Usage

```
## 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 'featherForecasts'
```

```

tfplot(x, tf=NULL, start=tfstart(tf), end=tfend(tf),
       series=seq(nseries(x)),
       Title="Predictions (dotted) and actual data (solid)",
       ylab=seriesNamesOutput(x),
       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 'multiModelHorizonForecasts'
tfplot(x,
       tf=NULL, start=tfstart(tf), end=tfend(tf), series=NULL, ...)

```

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 *Plots of Forecast Variance*

Description

Generate plots of forecast variance calculated by forecastCov.

Usage

```
## 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

<code>x</code>	The result of <code>forecastCov</code> .
<code>series</code>	integer or string indicating the series which should be plotted.
<code>select.cov</code>	logical indicating that for the case of multiple models select the covariance to be plotted.
<code>select.true</code>	logical indicating that results from the forecast of the true model (if available) should be plotted.
<code>select.zero</code>	logical indicating that results from a forecast of zero should be plotted.
<code>select.trend</code>	logical indicating that results from a forecast of trend should be plotted.
<code>graphs.per.page</code>	The number of graphs to put on a page.
<code>mar</code>	plot margins (see <code>par</code>).
<code>reset.screen</code>	logical indicating if the plot window should be cleared before starting.
<code>lty</code>	see details.
<code>Legend</code>	optional legend passed to <code>legend</code> .
<code>Title</code>	optional legend passed to <code>title</code> (but see details).
<code>y.limit</code>	optional limit on the y scale. Covariance values larger than <code>y.limit</code> will not be shown.
<code>line.labels</code>	logical indicating line labels should be printed.
<code>...</code>	For <code>forecastCov</code> objects this allows additional objects to be plotted. For <code>forecastCovEstimatorsWRTdata</code> ... 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**

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

tfplot.TSdata*Tfplot Specific Methods*

Description

See the generic function description.

Usage

```
## S3 method for class 'TSdata'
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()$mar, reset.screen=TRUE)
## S3 method for class 'TSestModel'
tfplot(x, ...,
       tf=NULL, start=tfstart(tf), end=tfend(tf),
       select.inputs=NULL, select.outputs=NULL,
       Title=NULL, xlab=NULL, ylab=NULL,
       graphs.per.page=5, mar=par()$mar, reset.screen=TRUE)
```

Arguments

<code>x</code>	object to be plotted.
<code>...</code>	additional objects to be plotted.
<code>start</code>	start of plot.
<code>end</code>	end of plot.
<code>tf</code>	an alternate way to specify start and end of plot.
<code>select.inputs</code>	series to be plotted. (passed to <code>selectSeries</code>)

<code>select.outputs</code>	series to be plotted. (passed to <code>selectSeries</code>)
<code>Title</code>	string to use for plot title (passed to <code>plot</code> - see <code>tfplot</code>).
<code>xlab</code>	string to use for x label (passed to <code>plot</code>).
<code>ylab</code>	string to use for y label (passed to <code>plot</code>).
<code>graphs.per.page</code>	integer indicating number of graphs to place on a page.
<code>mar</code>	margins passed to <code>plot</code> . See <code>par</code> .)
<code>reset.screen</code>	logical indicating if the plot window should be cleared before starting. If this is not TRUE then <code>mar</code> values will have no effect.

See Also

[tfplot](#)

tframed.TSdata

Specific Methods for tframed Data

Description

See the generic function description.

Usage

```
## 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

<code>x</code>	See the generic function.
<code>tf</code>	a time frame. See the generic function.
<code>value</code>	a time frame to associate with <code>x</code> .
<code>names</code>	A list with elements input and output which are strings passed as names to the default method.
<code>start</code>	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

```
toARMA(model, ...)
## 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, for example, Aoki, M. (1990) *State Space Modelling of Time Series*. 2d ed. rev. and enl., Springer-Verlag.

Aoki, M. and Havenner, A. (1991) State Space Modeling of Multiple Time Series. *Econometric Reviews*, **10**, 1–59.

See Also

[toSS fixConstants](#)

Examples

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

Tobs.TSdata

Specific Methods for tframed Data

Description

See the generic function description.

Usage

```
## 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](#)

TobsInput
*TSdata Periods***Description**

Apply a method to the input or output data.

Usage

```

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

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

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

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

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

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

```

```

endOutput(x)

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

  frequencyOutput(x)
  ## S3 method for class 'TSdata'
frequencyOutput(x)
  ## S3 method for class 'TSestModel'
frequencyOutput(x)

```

Arguments

x An object containing TSdata.

Details

Apply a method to the input or output data so, for example, `TobsInput(x)` in theory does `Tobs(inputData(x))`, which returns the number of observation periods in input data. The actual implementation may not do `Tobs(inputData(x))`. For example, with `TSPADIdata` `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

```

data("eg1.DSE.data.diff", package="dse")
TobsOutput(eg1.DSE.data.diff)

```

toSS

Convert to State Space Model

Description

Convert a model to state space form.

Usage

```

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=1e-14, ...)
## S3 method for class 'TSestModel'
toSSaugment(model, ...)

toSSnested(model, ...)
## S3 method for class 'ARMA'
toSSnested(model, n=NULL, Aoki=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

```
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 (O_m) as the measurement noise covariance. O_m would typically be an estimate of the output noise, such as returned in `$estimates$cov` of the function `l` (`l.SS` or `l.ARMA`). This assumes that the noise processes in the arbitrary SS representation are white and uncorrelated.

Usage

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

Arguments

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

Details

Convert to a non-innovations SS representation using a Cholesky decomposition of O_m 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

```

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

```
toSSinnov(model, ...)
```

Arguments

<code>model</code>	an object of class <code>TSmodel</code> .
<code>...</code>	arguments passed to other methods.

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 and 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)

```

toSSOform *Convert to Oform*

Description

Convert a state space model to (observability?) form.

Usage

```
toSSOform(model)
## S3 method for class 'TSmodel'
toSSOform(model)
## S3 method for class 'TSestModel'
toSSOform(model)
```

Arguments

`model` An object of class TSmodel.

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 <- estVARX1s(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

```
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

```
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.

See Also

[TSdata.object](#), [TSmodel](#), [TSestModel.object](#)

Examples

```
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

```
## 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 TSestModel.
select	an integer indicating which of multiple models to extract.
...	arguments to be passed to other methods.

See Also

[TSdata](#) [TSestModel](#) [TSmodel](#)

TSdata.object	<i>time series data object</i>
---------------	--------------------------------

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	<i>Estimated Time Series Model</i>
------------	------------------------------------

Description

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

Usage

```
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, estVARX1s. 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:sampleT,] - output[1:sampleT,]`

sampleT The end of the period (starting from 1) for which output is used for calculating one step ahead predictions.

predictT The end of the period for which the model is simulated. `sampleT` must be less than or equal `predictT`. If `predictT` is greater than `sampleT` then each step ahead beyond `sampleT` is based on the prediction of the previous step and not corrected by the prediction error.

The element `estimates` may optionally also contain an 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 $E[z(t)|sampleT]$.

track The smoothed estimate of the state tracking error $P(t|sampleT)$. 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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