Package 'BigVAR'

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Type Package

Title Dimension Reduction Methods for Multivariate Time Series

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Description More about what it does (maybe more than one line)

Depends RcppArmadillo, Rcpp, zoo, expm, methods, lattice

Imports MASS, vars

License GPL (>=2)

LazyLoad yes

LinkingTo Rcpp, RcppArmadillo

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A *Generator for Simulated Multivariate Time Series*

Description

Generator for Simulated Multivariate Time Series

Details

Example generator matrix adapted from Table 3.2 of Gredenhoff and Karlsson (1997)

Author(s)

Will Nicholson

References

Gredenhoff, Mikael, and Sune Karlsson. "Lag-length selection in VAR-models using equal and unequal lag-length procedures." Computational Statistics 14.2 (1999): 171-187.

BigVAR *Dimension Reduction Methods for Multivariate Time Series.*

Description

BigVAR contains a series of functions that allow for the estimation of Penalized Vector Autoregressive models.

Details

To use the facilities of this package, starting with an $k \times T$ multivariate time series and run `constructModel` to create an object of class `BigVAR`. `cv.BigVAR` creates an object of class `BigVAR.results`, which chooses an optimal penalty parameter based on minimizing h-step ahead forecasts on a specified cross-validation period over a grid of values as well as comparisons against AIC, unconditional mean, and a random walk. There are plot functions for both BigVAR (`plot.BigVAR`) and BigVAR.results (`plot`) as well as a predict function for BigVAR.results (`predict`).

Author(s)

Will Nicholson <wbn8@cornell.edu>,

References

Lutkepohl "New Introduction to Multivariate Time Series", Nicholson et al (2014)

See Also

constructModel, cv.BigVAR, BigVAR.results, plot), (predict

Examples

```
data(Y)
Y=Y[1:100,]
m1=constructModel(Y,p=4,struct="None",gran=c(50,10),
RVAR=FALSE,MN=FALSE,verbose=FALSE,h=1,cv="Rolling")
plot(m1)
results=cv.BigVAR(m1)
plot(results)
predict(results,n.ahead=1)
```

BigVAR-class *BigVAR Object Class*

Description

An object class to be used with cv.BigVAR

Details

Construct an object of class BigVAR via the function "ConstructModel"

Slots

`Data` a Txk multivariate time Series

`lagmax` Maximal lag order

`Structure` Penalty Structure

`Relaxed` Indicator for relaxed VAR

`Granularity` Granularity of Penalty Grid

`horizon` Desired Forecast Horizon

`crossval` Cross-Validation Procedure

`alpha` penalty for Sparse Group Lasso

`nseries` Number of Series

`Minnesota` Minnesota Prior Indicator

`verbose` Indicator for Verbose output

See Also

constructModel

BigVAR.results *BigVAR.results*

Description

This class contains the results from cv.BigVAR.

Details

It inherits the class BigVAR, but contains substantially more information.

Fields

`InSampMSFE` In-sample MSFE from optimal value of lambda

`LambdaGrid` Grid of candidate lambda values

`index` Rank of optimal lambda value

`OptimalLambda` Value of lambda which minimizes MSFE

`OOSMSFE` Average Out of sample MSFE of BigVAR model with Optimal Lambda

`seoosfmsfe` Standard Error of Out of sample MSFE of BigVAR model with Optimal Lambda

`MeanMSFE` Average Out of sample MSFE of Unconditional Mean Forecast

`MeanSD` Standard Error of out of sample MSFE of Unconditional Mean Forecast

`RWMSFE` Average Out of sample MSFE of Random Walk Forecast

`RWSD` Standard Error of out of sample MSFE of Random Walk Forecast

`AICMSFE` Average Out of sample MSFE of AIC Forecast

`AICSD` Standard Error of out of sample MSFE of AIC Forecast

`betaPred` The final out of sample coefficient matrix of `B`, to be used for prediction

`Zvals` The final lagged values of `Y`, to be used for prediction

`Data` a Txk multivariate time Series

`lagmax` Maximal lag order

`Structure` Penalty Structure

`Relaxed` Indicator for relaxed VAR

`Granularity` Granularity of Penalty Grid

`horizon` Desired Forecast Horizon

`crossval` Cross-Validation Procedure

`alpha` penalty for Sparse Group Lasso

`nseries` Number of Series

`Minnesota` Minnesota Prior Indicator

`verbose` verbose indicator

Note

One can also access any object of class BigVAR from BigVAR.results

Author(s)

Will Nicholson

`constructModel` *Construct an object of class BigVAR*

Description

Construct an object of class BigVAR

Usage

```
constructModel(Y, p, struct, gran, RVAR, h, cv, MN, verbose)
```

Arguments

`Y`	T x K multivariate time series
`p`	Predetermined maximal lag order
`struct`	The choice of penalty structure (see details).
`gran`	vector containing how deep to construct the penalty grid (parameter 1) and how many gridpoints to use (parameter 2)
`RVAR`	True or False: whether to refit using the Relaxed-VAR procedure
`h`	Desired forecast horizon
`cv`	Cross-validation approach, either "Rolling" for rolling cross-validation or "LOO" for leave-one-out cross-validation.
`MN`	Minnesota Prior Indicator
`verbose,`	Verbose output while estimating

Details

The choices for "struct" are as follows

- "None" (Lasso Penalty)
- "Group" (Block Group Lasso)
- "Sparse" (Block Sparse Group Lasso)
- "Diag" (Own/Other Group Lasso)
- "SparseDiag" (Own/Other Sparse Group Lasso)

Examples

```
library(BigVAR)
data(Y)
m1=constructModel(Y,p=4,struct="None",gran=c(50,10),
RVAR=FALSE,MN=FALSE,verbose=FALSE,h=1,cv="Rolling")
```

`cv.BigVAR` *Cross Validation for BigVAR*

Description

Performs rolling or leave-one-out cross-validation on a BigVAR object

Usage

```
cv.BigVAR(object)
```

Arguments

`object`	BigVAR object created from `ConstructModel`

Details

Will perform cross validation to select penalty parameters over a training sample, then evaluate them over a test set. Compares against sample mean, random walk, and AIC benchmarks. The resulting object is of class `BigVAR.results`

Value

An object of class `BigVAR.results`.

See Also

`constructModel`, `BigVAR.results`

Examples

```
data(Y)
Y=Y[1:100,]
m1=constructModel(Y,p=4,struct="None",gran=c(50,10),
RVAR=FALSE,MN=FALSE,h=1,cv="Rolling",verbose=FALSE)
results=cv.BigVAR(m1)
```

`MultVarSim` *Simulate a VAR*

Description

Simulate a VAR

Usage

```
MultVarSim(k, A1, p, Sigma, n)
```

Arguments

`k`	Number of Series
`A1`	Either a $k \times k$ coefficient matrix or a $kp \times kp$ matrix created using `VarptoVar1`.
`p`	Maximum Lag Order
`Sigma`	Residual Coariance Matrix of dimension $k \times k$
`n`	Number of simulations

Value

Returns a $n \times k$ of realizations from a VAR.

References

Lutkepohl, "A New Introduction to Multiple Time Series Analysis"

See Also

`VarptoVar1`

Examples

```
A1 <- matrix(c(.4,-.02,.01,-.02,.3,.02,.01,.04,.3),ncol=3,nrow=3)
A2 <- matrix(c(.2,0,0,0,.3,0,0,0,.13),ncol=3,nrow=3)
Ai=list()
Ai[[1]]=A1
Ai[[4]]=A2
k=6;p=3
A <- VarptoVar1(Ai,k,p)
Y <-MultVarSim(k,A,p,.1*diag(k),100)
```

plot.BigVAR *Plot a BigVAR object*

Description

Plot a BigVAR object

Usage

```
## S4 method for signature 'BigVAR,ANY'
plot(x, y = NULL, ...)
```

Arguments

x	BigVAR object created from ConstructModel
y	needed to mantain compatibility with generic, otherwise ignored
...	additional arguments

Details

Uses plot.zoo to plot each individual series of Y on a single plot

Value

NA, side effect is graph

See Also

constructModel

plot.BigVAR.results *Plot an object of class BigVAR.results*

Description

Plot an object of class BigVAR.results

Usage

```
## S4 method for signature 'BigVAR.results,ANY'
plot(x, y = NULL, ...)
```

Arguments

x	BigVAR.results object created from cv.BigVAR
y	Needed for compatibility with generic, otherwise ignored
...	additional arguments passed to generic

Details

Plots optimal lambda value

---

predict *Forecast using a BigVAR.results object*

Description

Forecast using a BigVAR.results object

Usage

```
predict(object,...)
```

Arguments

object	BigVAR.results object from cv.BigVAR
...	additional arguments affecting the predictions produced

Details

Provides n.ahead step forecasts using the model produced by cv.BigVAR.

See Also

cv.BigVAR

Examples

```
data(Y)
Y=Y[1:100,]
m1=constructModel(Y,p=4,struct="None",gran=c(50,10),MN=FALSE,
RVAR=FALSE,h=1,cv="Rolling",verbose=FALSE)
results=cv.BigVAR(m1)
predict(results,n.ahead=1)
```

show *Default show method for an object of class BigVAR.results*

Description

Default show method for an object of class BigVAR.results

Usage

```
## S4 method for signature 'BigVAR.results'
show(object)
```

Arguments

object	BigVAR.results object created from ConstructModel

Details

prints forecast information and comparisons with mean, random walk, and AIC benchmarks

See Also

cv.BigVAR

show.BigVAR *Default show method for an object of class BigVAR*

Description

Default show method for an object of class BigVAR

Usage

```
## S4 method for signature 'BigVAR'
show(object)
```

Arguments

object	BigVAR object created from ConstructModel

Value

Data prints the first 10 rows of Y

Structure prints desired structure'

Forecast Horizon

Relaxed Indicator

Maximum lag order p

See Also

constructModel

SparsityPlot *Sparsity Plot of a Coefficient Matrix*

Description

Sparsity Plot of a Coefficient Matrix

Usage

```
SparsityPlot(B, p, k, title = NULL)
```

Arguments

B	$k \times kp$ coefficient matrix
p	Maximal Lag order
k	Number of series
title	(optional) Plot title

Details

Similar to SparsityPlot.BigVAR, but the input object does not need to be of class BigVAR.results

Value

NA, side effect is graph

See Also

SparsityPlot.BigVAR.results,BigVAR.results

Examples

```
data(Generator)
k=3;p=4
SparsityPlot(A[1:k,],p,k,title="Sparsity Plot of Example Generator Matrix")
```

SparsityPlot.BigVAR.results *Sparsity Plot of a BigVAR.results object*

Description

Sparsity Plot of a BigVAR.results object

Usage

```
SparsityPlot.BigVAR.results(object)
```

Arguments

object	BigVAR.results object

Details

Uses levelplot from the lattice package to plot the magnitude of each coefficient

Value

NA, side effect is graph

See Also

SparsityPlot

VarptoVar1 *Converts a VAR of order p to a VAR of order 1*

Description

Converts a VAR of order p to a VAR of order 1

Usage

```
VarptoVar1(Ai, p, k)
```

Arguments

Ai	A list containing p k x k coefficient matrices
p	Lag order
k	Number of Series

Value

Returns a $kp \times kp$ coefficient matrix representing all matrices contained in Ai as a VAR(1).

References

See page 15 of Lutkepohl, "A New Introduction to Multiple Time Series Analysis"

See Also

MultVarSim

Examples

```
library(MASS)
A1 <- matrix(c(.4,-.02,.01,-.02,.3,.02,.01,.04,.3),ncol=3,nrow=3)
A2 <- matrix(c(.2,0,0,0,.3,0,0,0,.13),ncol=3,nrow=3)
Ai=list()
Ai[[1]]=A1
Ai[[4]]=A2
A <- VarptoVar1(Ai,6,3)
```

Y *Simulated Multivariate Time Series*

Description

Simulated Multivariate Time Series

Author(s)

Will Nicholson

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