Package ‘NetVAR’

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Type Package

Title Network Structures in VAR Models

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LazyLoad yes

LazyData true

Depends R (>= 3.5.0)

Imports fields, fGarch

Description Vector AutoRegressive (VAR) type models with tailored regularisation structures are provided to uncover network type structures in the data, such as influential time series (influencers). Currently the package implements the LISAR model from Zhang and Trimborn (2023) <doi:10.2139/ssrn.4619531>. The package automatically derives the required regularisation sequences and refines it during the estimation to provide the optimal model. The package allows for model optimisation under various loss functions such as Mean Squared Forecasting Error (MSFE), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC). It provides a dedicated class, allowing for summary prints of the optimal model and a plotting function to conveniently analyse the optimal model via heatmaps.

License GPL (>= 3)

NeedsCompilation yes

RoxygenNote 7.3.2

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Contents

LISAR *The LISAR model*

Description

LISAR contains the LISAR model described in Zhang and Trimborn (2023). The model is computed based on 3 lambda tuning parameters which are automatically determined by the package. A scaling parameter boosts/lowers the strength of the regularization on assets which values are determined less/more important than others (influencers). The function allows to compute the LISAR model under "LASSO", "SCAD" and "AdapLASSO".

Usage

```
LISAR(
  x,
  Model = "LISAR.LASSO",
  eval.criteria = "MSFE",
  Lags = 3,
  alpha.pens = 0.5,
  gamma.pens = 0.5,
  lambda1_seq = 0.5,
  lambda2_seq = 0.5,
  lambda3_seq = 0.5,
  a.pen = 3.7,
  eps1 = 1e-04,
  eps2 = 1e-04,
  T1 = NULL,
  T2 = NULL,
  reoptim = FALSE
)
```

Arguments

`x` A matrix containing the data with rows being observations and columns being time series.

`Model` The LISAR model to use with either LASSO "LISAR.LASSO", SCAD "LISAR.SCAD" or Adaptive LASSO "LISAR.AdapLASSO" regularization. Default "LISAR.LASSO".

`eval.criteria` The evaluation criteria to use to choose the best model under the regularization parameters. Can be either "MSFE", "AIC" or "BIC". Default "MSFE".

`Lags` The maximum number of lags to consider. Default 3.

`alpha.pens` A number or vector specifying the boosting parameter increasing/decreasing the strength of regularization. Should be a number(s) between (0,1). See Zhang and Trimborn (2023) for details on the alpha parameters.

`gamma.pens` A number or vector specifying the adaptive parameter for "LISAR.AdapLASSO". Only required for "LISAR.AdapLASSO". The number(s) should be larger than 0.

lambda1_seq The factor by which the regularization sequence of lambda1, regularizing the lag structure, decreases towards 0. Should be a value between (0,1).

lambda2_seq The factor by which the regularization sequence of lambda2, indicating which time series are more influential (influencers), decreases towards 0. Should be a value between (0,1).

lambda3_seq The factor by which the regularization sequence of lambda3, regularizing the individual parameters, decreases towards 0. Should be a value between (0,1).

a.pen The parameter specifying by which the SCAD penalty taperes off towards no regularization. Only required for "LISAR.SCAD". The number should be larger than 0. Default 3.7.

eps1 Control parameter for the inner optimization algorithm. The algorithm converged when between optimization steps the parameters change by less than "eps1". Default 0.0001.

eps2 Control parameter for the outer optimization algorithm. The algorithm converged when between optimization steps the parameters change by less than "eps2". Default 0.0001.

T1 A numeric stating the row of "x" where the training data end and the evaluation period starts. If NULL, then the first third of data are chosen as training data. Defaults to NULL.

T2 A numeric stating the row of "x" where the evaluation data end and the out-of-sample period starts. If NULL, then the second third of data are chosen as evaluation data. Defaults to NULL.

reoptim Logical. If TRUE, then the best model found under the initially derived lambda sequences is further optimized by a new lambda sequence around the previous best solution. Stops when a more granular lambda sequence no longer improves the model under "eval.criteria" criterion. Default "FALSE".

Value

An object of the class netstruc with the components

Model.optimal a list containing the optimal model, evaluation criteria and model regularizers

data.training the training data

data.evaluation the evaluation data

data.outofsample the out-of-sample data.

Model.estimation estimation specifics for the model

References

Kexin Zhang, Simon Trimborn (2023). Influential assets in Large-Scale Vector Autoregressive Models *SSRN Working paper*. doi:10.2139/ssrn.4619531

Examples

```
# Investigate influential assets relationship between 3 assets only
data(TradingData)

LISAR(TradingData[,c("AIG", "AXP", "BAC")], Model = "LISAR.LASSO", Lags = 1)

# Reoptimise the penalisation sequence
LISAR(TradingData[,c("AIG", "AXP", "BAC")], Model = "LISAR.LASSO", Lags = 1, reoptim = TRUE)


# Investigate influential assets relationship between the entire asset universe with starting values
LISAR(TradingData, Model = "LISAR.LASSO")

# Reoptimise the penalisation sequence
LISAR(TradingData, Model = "LISAR.LASSO", reoptim = TRUE)

# Consider a different model
LISAR(TradingData, Model = "LISAR.SCAD", Lags = 1)
```

`plot.NetVAR` *Plotting function for objects of class NetVAR*

Description

Plots an object of class NetVAR

Usage

```
## S3 method for class 'NetVAR'
plot(x, join_graphs = TRUE, scale_range = TRUE, legend = FALSE, ...)
```

Arguments

`x`	An object of `class` NetVAR
`join_graphs`	Logical. If TRUE, then heatmaps for each lagged parameter matrix are returned in one plot. If FALSE, a single figure per heatmap is generated.
`scale_range`	Logical. If TRUE, parameters larger 1 or smaller -1 are truncated to 1 and -1 purely for visualisation purposes. If FALSE, then the actual values are plotted in the heatmaps.
`legend`	Add a legend to plots. Default FALSE
`...`	Further arguments, currently none.

Value

None

print.NetVAR *Printing function for objects of class NetVAR*

Description

print.NetVAR prints the values of an object of class NetVAR.

Usage

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

Arguments

x	An object of class NetVAR
...	Further arguments to be passed over. Currently none.

Value

None

summary.NetVAR *Printing function for objects of class NetVAR*

Description

summary.NetVAR prints the values of an object of class NetVAR.

Usage

```
## S3 method for class 'NetVAR'
summary(object, ...)
```

Arguments

object	An object of class NetVAR
...	Further arguments to be passed over. Currently none.

Value

None

TradingData *Trading data for 11 US stocks from the finance sector*

Description

A dataset containing the 5 minute log returns of 11 US stocks for the 22.02.2022.

Format

A matrix with 5 minute trading data for 11 stocks on 22.02.2022.

Source

Yahoo-Finance.

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