Package ‘fastSOM’

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Fast Calculation of Spillover Measures

Description

This package comprises various functions for computing spillover measures, especially spillover tables and spillover indices as proposed by Diebold and Yilmaz (2009) as well as their estimated and exact average, minimal, and maximal values.

Details

Package: fastSOM
Type: Package
Version: 1.0.0
Date: 2016-07-20
License: GPL (>=2)

Author(s)

Stefan Kloessner (<S.Kloessner@mx.uni-saarland.de>),
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References


Calculation of the Spillover Index

Description

This function calculates the spillover index as proposed by Diebold and Yilmaz (2009, see References).

Usage

soi(Sigma, A, ncores = 1, ...)
Arguments

Sigma

Either a covariance matrix or a list thereof.

A

Either a 3-dimensional array with $A[,h]$ being MA coefficient matrices of the same dimension as $Sigma$ or a list thereof.

ncores

Number of cores, only relevant if Sigma is a list of matrices. Missing ncores or ncores=1 means no parallelization (just one core is used). ncores=0 means automatic detection of the number of available cores. Any other integer determines the maximal number of cores to be used.

...

Further arguments, especially perm which is used to reorder variables. If perm is missing, then the original ordering of the model variables will be used. If perm is a permutation of 1:N, then the spillover index for the model with variables reordered according to perm will be calculated.

Details

The spillover index was introduced by Diebold and Yilmaz in 2009 (see References). It is based on a variance decomposition of the forecast error variances of an $N$-dimensional MA($\infty$) process. The underlying idea is to decompose the forecast error of each variable into own variance shares and cross variance shares. The latter are interpreted as contributions of shocks of one variable to the error variance in forecasting another variable (see also sot). The spillover index then is a number between 0 and 100, describing the relative amount of forecast error variances that can be explained by shocks coming from other variables in the model.

The typical application of the 'list' version of soi is a rolling windows approach when Sigma and A are lists representing the corresponding quantities at different points in time (rolling windows).

Value

Returns a single numeric value or a list thereof.

Author(s)

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with contributions by Sven Wagner (<sven.wagner@mx.uni-saarland.de>)

References


See Also

fastSOM-package, sot
Examples

# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N), nrow=N))

# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*N), dim=c(N,N,H))

# calculate the spillover index
soi(Sigma, A)

soi_avg_est

Estimation of Average, Minimal, and Maximal Spillover Index

Description

Calculates an estimate of the average, the minimum, and the maximum spillover index based on different permutations.

Usage

soi_avg_est(Sigma, A, ncores = 1, ...)

Arguments

Sigma

Either a covariance matrix or a list thereof.

A

Either a 3-dimensional array with A[,] being MA coefficient matrices of the same dimension as Sigma or a list thereof.

ncores

Number of cores. Missing ncores or ncores=1 means no parallelization (just one core is used). ncores=0 means automatic detection of the number of available cores. Any other integer determines the maximal number of cores to be used.

...

Further arguments, especially perms which is used to reorder variables. If perms is missing, then 10,000 randomly created permutations of 1:N will be used as reorderings of the model variables. If perms is defined, it has to be either a matrix with each column being a permutation of 1:N, or, alternatively, an integer value defining the number of randomly created permutations.

Details

The spillover index introduced by Diebold and Yilmaz (2009) (see References) depends on the ordering of the model variables. While soi_avg_exact provides a fast algorithm for exact calculation of average, minimum, and maximum of the spillover index over all permutations, there might be reasons to prefer to estimate these quantities using a limited number of permutations (mainly to save time when N is large). This is exactly what soi_avg_est does.

The typical application of the 'list' version of soi_avg_est is a rolling windows approach when Sigma and A are lists representing the corresponding quantities at different points in time (rolling windows).
soi_avg_exact

Value

The 'single' version returns a list containing the estimated average, minimal, and maximal spillover index as well as permutations that generated the minimal and maximal value. The 'list' version returns a list consisting of three vectors (the average, minimal, and maximal spillover index values) and two matrices (the columns of which are the permutations generating the minima and maxima).

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References


See Also

fastSOM-package, soi_avg_exact

Examples

# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N),nrow=N))
# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*H),dim=c(N,N,H))
# calculate estimates of the average, minimal, # and maximal spillover index and determine the corresponding ordering # of the model variables
soi_avg_est(Sigma, A)

soi_avg_exact

Exact Calculation of Average, Minimal, and Maximal Spillover Index

Description

Calculates the Average, Minimal, and Maximal Spillover Index exactly.

Usage

soi_avg_exact(Sigma, A, ncores = 1)
soi_avg_exact

Arguments

Sigma
Either a covariance matrix or a list thereof.

A
Either a 3-dimensional array with A[,h] being MA coefficient matrices of the same dimension as Sigma or a list thereof.

ncores
Number of cores. Missing ncores or ncores=1 means no parallelization (just one core is used). ncores=0 means automatic detection of the number of available cores. Any other integer determines the maximal number of cores to be used.

Details

The spillover index introduced by Diebold and Yilmaz (2009) (see References) depends on the ordering of the model variables. While soi_avg_est provides an algorithm to estimate average, minimum, and maximum of the spillover index over all permutations, soi_avg_est calculates these quantities exactly. Notice, however, that for large dimensions N, this might be quite time- as well as memory-consuming. If only the exact average of the spillover index is wanted, soi_from_sot(sot_avg_exact(Sigma,A,ncores)$Average) should be used.

The typical application of the 'list' version of soi_avg_exact is a rolling windows approach when Sigma and A are lists representing the corresponding quantities at different points in time (rolling windows).

Value

The 'single' version returns a list containing the exact average, minimal, and maximal spillover index as well as permutations that generated the minimal and maximal value. The 'list' version returns a list consisting of three vectors (the average, minimal, and maximal spillover index values) and two matrices (the columns of which are the permutations generating the minima and maxima).

Author(s)

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References


See Also

fastSOM-package, soi_avg_est
soi_from_sot  Calculation of the Spillover Index for a given Spillover Table

Description

Given a spillover table, this function calculates the corresponding spillover index.

Usage

soi_from_sot(input_table)

Arguments

input_table Either a spillover table or a list thereof

Details

The spillover index was introduced by Diebold and Yilmaz in 2009 (see References). It is based on a variance decomposition of the forecast error variances of an $N$-dimensional MA($\infty$) process. The underlying idea is to decompose the forecast error of each variable into own variance shares and cross variance shares. The latter are interpreted as contributions of shocks of one variable to the error variance in forecasting another variable (see also sot). The spillover index then is a number between 0 and 100, describing the relative amount of forecast error variances that can be explained by shocks coming from other variables in the model.

The typical application of the 'list' version of soi_from_sot is a rolling windows approach when input_table is a list representing the corresponding spillover tables at different points in time (rolling windows).

Value

Numeric value or a list thereof.

Author(s)

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References


See Also

fastSOM-package, soi, sot

Examples

# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N),nrow=N))
# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*H),dim=c(N,N,H))
# calculate spillover table
SOT <- sot(Sigma,A)
# calculate spillover index from spillover table
soi_from_sot(SOT)

Calculation of Spillover Tables

Description

This function calculates an $N \times N$-dimensional spillover table.

Usage

sot(Sigma, A, ncores = 1, ...)

Arguments

Sigma
Either a covariance matrix or a list thereof.

A
Either a 3-dimensional array with $A[,]h$ being MA coefficient matrices of the same dimension as Sigma or a list thereof.

ncores
Number of cores, only relevant if Sigma is a list of matrices. Missing ncores or ncores=1 means no parallelization (just one core is used). ncores=0 means automatic detection of the number of available cores. Any other integer determines the maximal number of cores to be used.

Further arguments, especially perm which is used to reorder variables. If perm is missing, then the original ordering of the model variables will be used. If perm is a permutation of 1:N, then the spillover index for the model with variables reordered according to perm will be calculated.
Details

The \((i,j)\)-entry of a spillover table represents the relative contribution of shocks in variable \(j\) (the column variable) to the forecasting error variance of variable \(i\) (the row variable). Hence, off-diagonal values are interpreted as spillovers, while the own variance shares appear on the diagonal. An overall spillover measure is given by \texttt{sot}.

The typical application of the 'list' version of \texttt{sot} is a rolling windows approach when \(\Sigma\) and \(\alpha\) are lists representing the corresponding quantities at different points in time (rolling windows).

Value

Matrix, or a list thereof, of dimensions \(N \times N\) with non-negative entries summing up to 100 for each row.

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References


See Also

\texttt{fastSOM-package}, \texttt{soi}

Examples

```r
# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N),nrow=N))
# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*H),dim=c(N,N,H))
# calculate spillover table
sot(Sigma,A)
```
sot_avg_est

Estimation of the Average, Minimal, and Maximal Entries of a Spillover Table

Description

Calculates estimates of the average, minimal, and maximal entries of a spillover.

Usage

sot_avg_est(Sigma, A, ncores = 1, ...)

Arguments

- **Sigma**: Either a covariance matrix or a list thereof.
- **A**: Either a 3-dimensional array with A[,h] being MA coefficient matrices of the same dimension as Sigma or a list thereof.
- **ncores**: Number of cores. Missing ncores or ncores=1 means no parallelization (just one core is used). ncores=0 means automatic detection of the number of available cores. Any other integer determines the maximal number of cores to be used.
- **...**: Further arguments, especially `perms` which is used to reorder variables. If `perms` is missing, then 10,000 randomly created permutations of 1:N will be used as reorderings of the model variables. If `perms` is defined, it has to be either a matrix with each column being a permutation of 1:N, or, alternatively, an integer value defining the number of randomly created permutations.

Details

The spillover tables introduced by Diebold and Yilmaz (2009) (see References) depend on the ordering of the model variables. While `sot_avg_exact` provides a fast algorithm for exact calculation of average, minimum, and maximum of the spillover table over all permutations, there might be reasons to prefer to estimate these quantities using a limited number of permutations (mainly to save time when N is large). This is exactly what `sot_avg_est` does.

The typical application of the 'list' version of `sot_avg_est` is a rolling windows approach when `Sigma` and `A` are lists representing the corresponding quantities at different points in time (rolling windows).

Value

The 'single' version returns a list containing the exact average, minimal, and maximal values for the spillover table. The 'list' version returns a list with three elements (Average, Minimum, Maximum) which themselves are lists of the corresponding tables.
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References

See Also
fastSOM-package, sot_avg_exact

Examples
# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N), nrow=N))
# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*H), dim=c(N,N,H))
# calculate estimates of the average, minimal, # and maximal entries within a spillover table
sot_avg_est(Sigma, A)

sot_avg_exact

Calculation of the Exact Values for Average, Minimal, and Maximal Entries of a Spillover Table

Description
Calculates the exact values of the average, the minimum, and the maximum entries of a spillover tables based on different permutations.

Usage
sot_avg_exact(Sigma, A, ncores = 1)

Arguments
Sigma
Either a covariance matrix or a list thereof.
A
Either a 3-dimensional array with A[,h] being MA coefficient matrices of the same dimension as Sigma or a list thereof.
ncores

Number of cores, only relevant for ‘list’ version. In this case, missing ncores or ncores=1 means no parallelization (just one core is used), ncores=0 means automatic detection of the number of available cores, any other integer determines the maximal number of cores to be used.

Details

The spillover tables introduced by Diebold and Yilmaz (2009) (see References) depend on the ordering of the model variables. While sot_avg_est provides an algorithm to estimate average, minimal, and maximal values of the spillover table over all permutations, sot_avg_exact calculates these quantities exactly. Notice, however, that for large dimensions $N$, this might be quite time- as well as memory-consuming.

The typical application of the ‘list’ version of sot_avg_exact is a rolling windows approach when $\Sigma$ and $\alpha$ are lists representing the corresponding quantities at different points in time (rolling windows).

Value

The ‘single’ version returns a list containing the exact average, minimal, and maximal values for the spillover table. The ‘list’ version returns a list with three elements (Average, Minimum, Maximum) which themselves are lists of the corresponding tables.

Author(s)

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with contributions by Sven Wagner (<sven.wagner@mx.uni-saarland.de>)

References


See Also

fastSOM-package, sot_avg_est

Examples

# generate randomly positive definite matrix Sigma of dimension N
N <- 10
Sigma <- crossprod(matrix(rnorm(N*N),nrow=N))
# generate randomly coefficient matrices
H <- 10
A <- array(rnorm(N*N*H),dim=c(N,N,H))
# calculate the exact average, minimal, # and maximal entries within a spillover table sot_avg_exact(Sigma, A)
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