Package ‘TrendTM’

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Type Package

Title Trend of High-Dimensional Time Series Matrix Estimation

Version 2.0.21

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Description
Matrix factorization for multivariate time series with both low rank and temporal structures.
The procedure is the one proposed by Alquier, P. and Marie, N.
``Matrix factorization for multivariate time series analysis.''
Electronic Journal of Statistics, 13(2), 4346-4366 (2019).

Depends R (>= 3.5.0)

License GPL-3

Encoding UTF-8

LazyData true

RoxygenNote 7.3.2

Imports softImpute, capushe, fda

NeedsCompilation no

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Contents

Data_Series — *Example of data*

Description

A simulated matrix with a low rank k and with temporal structure based on independent Gaussian.

Usage

```
data(Data_Series)
```

Format

A matrix with 30 rows (30 times series) and 100 columns (size of each temporal series).

Examples

```
library(TrendTM)
data(Data_Series)
head(Data_Series)
TrendTM(Data_Series,k_max=3)
```

FM_kt — *It performs the factorization for a fixed rank k and a temporal structure with a fixed tau*

Description

It performs the factorization for a fixed rank k and a temporal structure with a fixed tau

Usage

```
FM_kt(
  Data_Series,
  k = 2,
  tau = floor(n/2),
  struct_temp = "none",
  type_soft = "als"
)
```

Arguments

`Data_Series`	the data matrix with d rows and n columns containing the d temporal series with size n.
`k`	the fixed rank of X. Default is 2.
`tau`	the fixed value for tau . Default is `floor(n/2)`.
`struct_temp`	a name indicating the temporal structure. Could be `none`, `periodic` or `smooth`. Default is `none`.
`type_soft`	the option `type` of the function softImpute. Default is `als`.

Value

A list containing

- `M_est` the estimation of M.
- `U_est` the component U of the decomposition of `M_est`.
- `V_est` the component V of the decomposition of `M_est`.
- `contrast` the Frobenius norm of X-M_est.

`OurSlope` *It performs the slope heuristic for the selection of a penalty constant*

Description

It performs the slope heuristic for the selection of a penalty constant

Usage

```
OurSlope(contrast, grille, penalty)
```

Arguments

`contrast`	the Frobenius norm of X-M_est for all the value of the grid `grille`
`grille`	the ordered grid of potential values for the penalty constant
`penalty`	the penalty calculated for each value of the grid `grille`

Value

`Model_Selected` the selected parameter

TrendTM *Matrix Factorization for Multivariate Time Series Analysis*

Description

It is the main function. It performs the factorization for a selected rank and a temporal structure with a selected tau if the selection is requested otherwise it is fixed

Usage

```
TrendTM(
  Data_Series,
  k_select = FALSE,
  k_max = 20,
  struct_temp = "none",
  tau_select = FALSE,
  tau_max = floor(n/2),
  type_soft = "als"
)
```

Arguments

`Data_Series`	the data matrix with d rows and n columns containing the d temporal series with size n.
`k_select`	a boolean indicating if the rank of the matrix Data_Series will be selected. Default is FALSE.
`k_max`	the fixed rank of Data_Series if `k_select=FALSE`. The maximal value of the rank if `k_select=TRUE` (must be lower than the minimum between d and n). Default is 20.
`struct_temp`	a name indicating the temporal structure. Could be `none`, `periodic` or `smooth`. Default is `none`.
`tau_select`	a boolean indicating if the parameter tau will be selected. This can be possible only when `struct_temp=smooth`. Default is FALSE.
`tau_max`	the fixed value for tau if `tau_select=FALSE`. The maximal value of tau if `tau_select=TRUE` (must be lower than n). Default is `floor(n/2)`.
`type_soft`	the option `type` of the function softImpute. Default is `als`.

Details

The penalty constant(s) is(are) calibrated using the slope heuristic from package capushe. We adapt this heuristic as follows: the final dimension is the one correspind to the majority of the selected dimension for the considered different penalties.

Value

A list containing

- k_est the selected rank if k_select==TRUE or k_max if k_select==FALSE.
- tau_est the selected tau if tau_select==TRUE or tau_max if tau_select==FALSE.
- U_est the component U of the decomposition of the final estimator M_est.
- V_est the component V of the decomposition of the final estimator M_est.
- M_est the estimation of M.
- contrast the Frobenius norm of Data_Series-M_est. This is a value when k_select==FALSE and tau_select==FALSE, a vector when k_select==TRUE or tau_select==TRUE, and a matrix when k_select==TRUE and tau_select==TRUE with k_max rows and tau_max columns.

Examples

```
data(Data_Series)
result <- TrendTM(Data_Series, k_max = 3)
```

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