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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