Package: RMFM (via r-universe)

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Type Package

Title Robust Matrix Factor Model

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Description We introduce a robust matrix factor model that explicitly incorporates tail behavior and employs a mean-shift term to avoid efficiency losses through pre-centering of observed matrices. More details on the methods related to our paper are currently under submission. A full reference to the paper will be provided in future versions once the paper is published.

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Depends irlba, R (>= 3.5.0)

Imports stats, LaplacesDemon, MixMatrix, COAP, Rcpp (>= 1.0.10)

Suggests knitr, rmarkdown

LinkingTo Rcpp, RcppArmadillo

Encoding UTF-8

RoxygenNote 7.3.2

NeedsCompilation yes

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ER.RMFM *Select the structure dimension of factor matrix*

Description

Select the structure dimension of factor matrix in the high-dimensional robust matrix factor model

Usage

```
ER.RMFM(
  X,
  r_max = 10,
  epsELBO = 1e-09,
  maxIter = 20,
  verbose = FALSE,
  seed = 1
)
```

Arguments

X	a p1* p2*T array, which is the observed matrix from each individual, where T is the sample size.
r_max	an optional positive integer, specify the upper bound of row and column factors; default as 10.
epsELBO	an optional positive value, tolerance of relative variation rate of the variational lower bound value, default as '1e-9'.
maxIter	the maximum iteration of the VEM algorithm. The default is 30.
verbose	a logical value, whether output the information in iteration.
seed	an optional integer, specify the random seed for reproducibility in initialization.

Details

None

Value

return a list including the following components:

- rvec - a two-dimensional vector, the estimated row and column numbers of factors.
- svrMat - a r_max-by-2 matrix, the singular value ratios.

References

None

See Also

None

Examples

```
r1 <- 4; r2 <- 3;
Tt <- 100; type <- 'MatrixT'
p1 <- 50; p2 <- 50
datlist <- gendata_rmfm(Tt = Tt,p1 =p1, p2=p2, r1=r1, r2=r2,
                        rho=1, type= 'MatrixT', nu=3)
str(datlist)
res <- ER.RMFM(datlist$X, r_max=10,   epsELBO=1e-9, maxIter=10, verbose=FALSE, seed=1)
res
```

---

gendata_rmfm *Generate simulated data*

Description

Generate simulated data from robust matrix factor models

Usage

```
gendata_rmfm(
  Tt = 100,
  p1 = 50,
  p2 = 40,
  r1 = 4,
  r2 = 3,
  rho = 0.01,
  type = c("MatrixT", "MatrixN"),
  nu = 1
)
```

Arguments

Tt	a positive integer, specify the sample size.
p1	a positive integer, specify the row dimension of the observed matrix.
p2	a positive integer, specify the column dimension of the observed matrix.
r1	a positive integer, specify the number of row factors; default as 4
r2	a positive integer, specify the number of column factors; default as 3.
rho	a positive real, specify the signal strength of factor matrices.
type	a string, specify the type of error matrix, default as `type='MatrixN'`; supportint matrix t distribution 'MatrixT' and matrix normal distribution 'MatrixN'.
nu	a positive integer, specify the degree freedom of the matrix t distribution when `type='MatrixT'`.

Value

return a list including the following components:

- `X` - p1* p2*T array, which is the observed matrix from each individual, where T is the sample size.
- `CC` - p1* p2*T array, which is the common component matrix for each individual.
- `F0` - r1* r2*T array, which is the generated factor matrix for each individual, where T is the sample size.
- `R0` - a p1-by-r1 matrix, the row loading matrix.
- `C0` - a p2-by-r2 matrix, the column loading matrix.
- `mu0` - a p1-by-p2 matrix, the mean matrix.

Examples

```
r1 <- 4; r2 <- 3;
Tt <- 100; type <- 'MatrixT'
p1 <- 100; p2 <- 50
datlist <- gendata_rmfm(Tt = Tt,p1 =p1, p2=p2, r1=r1, r2=r2,
                        rho=0.01, type=type, nu=1)
str(datlist)
```

`RMFM` *Fit the high-dimensional robust matrix factor model*

Description

Fit the high-dimensional robust matrix factor model via variational inference.

Usage

```
RMFM(
  X,
  r1 = 10,
  r2 = 10,
  epsELBO = 1e-09,
  maxIter = 30,
  verbose = TRUE,
  seed = 1,
  cal_eigs = FALSE
)
```

Arguments

X	a p1* p2*T array, which is the observed matrix from each individual, where T is the sample size.
r1	an optional positive integer, specify the number of row factors; default as 10.
r2	an optional positive integer, specify the number of column factors; default as 10.
epsELBO	an optional positive value, tolerance of relative variation rate of the variational lower bound value, default as '1e-9'.
maxIter	the maximum iteration of the VEM algorithm. The default is 30.
verbose	a logical value, whether output the information in iteration.
seed	an optional integer, specify the random seed for reproducibility in initialization.
cal_eigs	an optional logical value, specify whether calculate the eigenvalues of covariance matrix, default as FALSE.

Details

None

Value

return a list including the following components:

- hF - a r1* r2*T array, which is the estimated factor matrix for each individual, where T is the sample size.
- hmu - a p1-by-p2 matrix, the estimated mean matrix.
- hR - the estimated row loading matrix.
- hC - the estimated column loading matrix.
- hnu - the estimated degree of freedom for the error term.
- hLambda1 - a p1 vector, the estimated row scatter matrix for error.
- hLambda2 - a p2 vector, the estimated column scatter matrix for error.
- dR - NULL if cal_eigs=FALSE; a group of eigenvalues of the sample covariance across rows if cal_eigs=TRUE.
- dC - NULL if cal_eigs=FALSE; a group of eigenvalues of the sample covariance across columns if cal_eigs=TRUE.
- ELBO - the ELBO value when algorithm stops;
- ELBO_seq - the sequence of ELBO values.
- time_use - the running time in model fitting of RMFM;

References

None

See Also

None

Examples

```
r1 <- 4; r2 <- 3;
Tt <- 100; type <- 'MatrixT'
p1 <- 50; p2 <- 50
datlist <- gendata_rmfm(Tt = Tt,p1 =p1, p2=p2, r1=r1, r2=r2,
                        rho=1, type= 'MatrixT', nu=1)
str(datlist)
reslist <- RMFM(X=datlist$X, r1=r1, r2=r2,  verbose = TRUE, maxIter = 6)
```

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