

# 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.

**License** GPL-3

**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:

- $X$  -  $p_1 \times p_2 \times T$  array, which is the observed matrix from each individual, where  $T$  is the sample size.
- $CC$  -  $p_1 \times p_2 \times T$  array, which is the common component matrix for each individual.
- $F_0$  -  $r_1 \times r_2 \times T$  array, which is the generated factor matrix for each individual, where  $T$  is the sample size.
- $R_0$  - a  $p_1$ -by- $r_1$  matrix, the row loading matrix.
- $C_0$  - a  $p_2$ -by- $r_2$  matrix, the column loading matrix.
- $\mu_0$  - a  $p_1$ -by- $p_2$  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)
```

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 RMFM

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*Fit the high-dimensional robust matrix factor model*


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**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 $p_1 \times p_2 \times T$ 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  $r_1 \times r_2 \times T$  array, which is the estimated factor matrix for each individual, where T is the sample size.
- hmu - a  $p_1$ -by- $p_2$  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  $p_1$  vector, the estimated row scatter matrix for error.
- hLambda2 - a  $p_2$  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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