

# Package ‘MKendall’

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**Type** Package

**Title** Matrix Kendall's Tau and Matrix Elliptical Factor Model

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**Author** Yong He [aut],  
Yalin Wang [aut, cre],  
Long Yu [aut],  
Wang Zhou [aut],  
Wenxin Zhou [aut]

**Maintainer** Yalin Wang <wangyalin@mail.sdu.edu.cn>

**Description** Large-scale matrix-variate data have been widely observed nowadays in various research areas such as finance, signal processing and medical imaging. Modelling matrix-valued data by matrix-elliptical family not only provides a flexible way to handle heavy-tail property and tail dependencies, but also maintains the intrinsic row and column structure of random matrices. We proposed a new tool named matrix Kendall's tau which is efficient for analyzing random elliptical matrices. By applying this new type of Kendall's tau to the matrix elliptical factor model, we propose a Matrix-type Robust Two-Step (MRTS) method to estimate the loading and factor spaces. See the details in He et al. (2022) <[arXiv:2207.09633](https://arxiv.org/abs/2207.09633)>. In this package, we provide the algorithms for calculating sample matrix Kendall's tau, the MRTS method and the Matrix Kendall's tau Eigenvalue-Ratio (MKER) method which is used for determining the number of factors.

**License** GPL-2

**Encoding** UTF-8

**NeedsCompilation** no

**Repository** CRAN

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MKER

*Estimating Factor Numbers via Matrix Kendall's Tau Eigenvalue-Ratio Method*

### Description

This function is to estimate row and column factor numbers via Matrix Kendall's Tau Eigenvalue-Ratio Method.

### Usage

```
MKER(X, kmax)
```

### Arguments

X	Input three-dimensional array, of dimension $T \times p \times q$ . $T$ is the sample size, $p$ is the row dimension of each matrix observation and $q$ is the column dimension of each matrix observation.
kmax	The user-supplied maximum factor numbers.

### Details

See He et al. (2022) <arXiv:2207.09633> for details.

### Value

khat	The estimated row factor number.
rhat	The estimated column factor number.

### Author(s)

Yong He, Yalin Wang, Long Yu, Wang Zhou and Wenxin Zhou.

### References

He, Y., Wang, Y., Yu, L., Zhou, W., & Zhou, W. X. (2022). A new non-parametric Kendall's tau for matrix-value elliptical observations <arXiv:2207.09633>.

### Examples

```
set.seed(123456)
T=20;p=10;q=10;k=2;r=2
R=matrix(runif(p*k,min=-1,max=1),p,k)
C=matrix(runif(q*r,min=-1,max=1),q,r)
X=Y=E=array(0,c(T,p,q))
for(i in 1:T){
  Y[i,,]=R%%matrix(rnorm(k*r),k,r)%*%t(C)
  E[i,,]=matrix(rnorm(p*q),p,q)
```

```

    }
    X=Y+E

fn=MKER(X,9)
fn$khhat;
fn$rhat

```

MRTS

*Matrix Robust Two-Step Algorithm for Large-Dimensional Matrix Elliptical Factor Model*

### Description

This function is to fit the large-dimensional matrix elliptical factor model via the Matrix Robust Two-Step (RTS) algorithm.

### Usage

```
MRTS(X, k, r)
```

### Arguments

X	Input three-dimensional array, of dimension $T \times p \times q$ . $T$ is the sample size, $p$ is the row dimension of each matrix observation and $q$ is the column dimension of each matrix observation.
k	A positive integer indicating the row factor numbers.
r	A positive integer indicating the column factor numbers.

### Details

See He et al. (2022) <arXiv:2207.09633> for details.

### Value

The return value is a list. In this list, it contains the following:

Rloading	The estimated row loading matrix of dimension $p \times k$
Cloading	The estimated column loading matrix of dimension $q \times r$
Fhat	The estimated factor matrices, are output in the form of a three-dimensional array with dimensions of $T \times k \times r$ . $T$ is the sample size, $k$ and $r$ are the row and column dimensions of each factor matrix, respectively.

### Author(s)

Yong He, Yalin Wang, Long Yu, Wang Zhou and Wenxin Zhou.

## References

He, Y., Wang, Y., Yu, L., Zhou, W., & Zhou, W. X. (2022). A new non-parametric Kendall's tau for matrix-value elliptical observations <arXiv:2207.09633>.

## Examples

```
set.seed(123456)
T=20;p=10;q=10;k=2;r=2
R=matrix(runif(p*k,min=-1,max=1),p,k)
C=matrix(runif(q*r,min=-1,max=1),q,r)
X=Y=E=array(0,c(T,p,q))
  for(i in 1:T){
    Y[i,,]=R%%matrix(rnorm(k*r),k,r)%*%t(C)
    E[i,,]=matrix(rnorm(p*q),p,q)
  }
X=Y+E

fit=MRTS(X,k,r)
fit$Rloading;fit$Cloading;fit$Fhat
```

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 MSK

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*Estimating Row and Column Sample Matrix Kendall's Tau*


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## Description

This function is to estimate row and column sample matrix Kendall's tau which are defined in He et al. (2022) <arXiv:2207.09633>

## Usage

```
MSK(X, type = "1")
```

## Arguments

X	Input three-dimensional array, of dimension $T \times p \times q$ . $T$ is the sample size, $p$ is the row dimension of each matrix observation and $q$ is the column dimension of each matrix observation.
type	If type=1, calculate the row sample matrix Kendall's tau; if type=2, calculate the column sample matrix Kendall's tau. The default is the row sample matrix Kendall's tau.

## Details

See He et al. (2022) <arXiv:2207.09633> for details.

## Value

If type=1, the return value is a  $p \times p$  matrix; if type=2, the return value is a  $q \times q$  matrix.

**Author(s)**

Yong He, Yalin Wang, Long Yu, Wang Zhou and Wenxin Zhou.

**References**

He, Y., Wang, Y., Yu, L., Zhou, W., & Zhou, W. X. (2022). A new non-parametric Kendall's tau for matrix-value elliptical observations <arXiv:2207.09633>.

**Examples**

```
X=array(rnorm(400),c(20,5,4))  
MSK(X,1)
```

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