Package ‘MN’

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Type Package

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Description Density computation, random matrix generation and maximum likelihood estimation of the matrix normal distribution. References: Pocuca N., Gallaugher M. P., Clark K. M. & McNicholas P. D. (2019). Assessing and Visualizing Matrix Variate Normality. <doi:10.48550/arXiv.1910.02859> and the relevant wikipedia page.

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Contents

`MN-package` *Matrix Normal Distribution*

Description

Density computation, random matrix generation and maximum likelihood estimation of the matrix normal distribution. For references see: Pocuca N., Gallaugher M. P., Clark K. M. & McNicholas P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859 and the relevant wikipedia page.

Details

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Maintainers

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Author(s)

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References

Pocuca, N., Gallaugher, M. P., Clark, K. M., & McNicholas, P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859.

`Density of the matrix normal distribution`
Density of the matrix normal distribution

Description

Density of the matrix normal distribution.

Usage

```
dmn(X, M, U, V, logged = FALSE)
```

Arguments

`X`	A list with k elements, k matrices of dimension $n\ timesp$ each. In the case of one matrix only, this may be given as a numerical matrix and not as an element in a list.
`M`	The mean matrix of the distribution, a numerical matrix of dimensions $n \times p$.
`U`	The covariance matrix associated with the rows, a numerical matrix of dimensions $n \times n$.
`V`	The covariance matrix associated with the columns, a numerical matrix of dimensions $p \times p$.
`logged`	Should the logarithm of the density be computed?

Value

A numeric vector with the (logged) density values.

Author(s)

Omar Alzeley.

R implementation and documentation: Omar Alzeley `<oazeley@uqu.edu.sa>`.

References

https://en.wikipedia.org/wiki/Matrix_normal_distribution#Definition

Pocuca, N., Gallaugher, M. P., Clark, K. M., & McNicholas, P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859.

See Also

`rmn`, `mn.mle`, `ddplot`

Examples

```
M <- as.matrix(iris[1:8, 1:4])
U <- cov( matrix( rnorm(100 * 8), ncol = 8 ) )
V <- cov( iris[1:50, 1:4] )
X <- rmn(10, M, U, V)
dmn(X, M, U, V, TRUE)
```

Distance-Distance Plot *Distance-Distance Plot*

Description

Distance-Distance Plot

Usage

```
ddplot(X, M, U, V)
```

Arguments

X	A list with k elements, k matrices of dimension $n\ timesp$ each. In the case of one matrix only, this may be given as a numerical matrix and not as an element in a list.
M	The mean matrix of the distribution, a numerical matrix of dimensions $n \times p$.
U	The covariance matrix associated with the rows, a numerical matrix of dimensions $n \times n$.
V	The covariance matrix associated with the columns, a numerical matrix of dimensions $p \times p$.

Details

The distance-distance plot is produced. This is a scatter plot of the Mahalanobis distances computed using the estimated parameters from the multivariate normal and matrix normal distribution. See Pocuca et al. (2019) for more details.

Value

A scatter plot of the Mahalanobis distances.

Author(s)

Michail Tsagris and Omar Alzeley.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr> and Omar Alzeley <oazeley@uqu.edu.sa>.

References

Pocuca N., Gallaugher M. P., Clark K. M. & McNicholas P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859.

See Also

rmn, mn.mle, dmn, ddkstest

Examples

```
M <- as.matrix(iris[1:8, 1:4])
U <- cov( matrix( rnorm(100 * 8), ncol = 8 ) )
V <- cov( iris[1:50, 1:4] )
X <- rmn(100, M, U, V)
ddplot(X, M, U, V)
```

Kolmogorov-Smirnov test for matrix normality

Kolmogorov-Smirnov test for matrix normality

Description

Kolmogorov-Smirnov test for matrix normality

Usage

```
ddkstest(X, M, U, V, alpha = 0.05)
```

Arguments

X	A list with k elements, k matrices of dimension $n\ timesp$ each. In the case of one matrix only, this may be given as a numerical matrix and not as an element in a list.
M	The mean matrix of the distribution, a numerical matrix of dimensions $n \times p$.
U	The covariance matrix associated with the rows, a numerical matrix of dimensions $n \times n$.
V	The covariance matrix associated with the columns, a numerical matrix of dimensions $p \times p$.
alpha	The significance level for the test, set by default equal to 0.05.

Details

The Kolmogorov-Smirnov test for matrix normality is performed. See Pocuca (2019) for more details.

Value

A message. If the Kronecker product covariance structure is not present, the message reads "Reject" and "Not reject otherwise".

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

Pocuca N., Gallaugher M. P., Clark K. M. & McNicholas P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859.

See Also

rmn, mn.mle, dmn, ddplot

Examples

```
M <- as.matrix(iris[1:8, 1:4])
U <- cov( matrix( rnorm(100 * 8), ncol = 8 ) )
V <- cov( iris[1:50, 1:4] )
X <- rmn(200, M, U, V)
ddkstest(X, M, U, V)
```

Maximum likelihood estimation of the the matrix normal distribution
Maximum likelihood estimation of the the matrix normal distribution

---

Description

Maximum likelihood estimation of the the matrix normal distribution.

Usage

```
mn.mle(X)
```

Arguments

X	A list with k elements (k is the sample size), k matrices of dimension $n timesp$ each.

Value

A list including:

runtime	The runtime required for the whole fitting procedure.
iters	The number of iterations required for the estimation of the U and V matrices.
M	The estimated mean matrix of the distribution, a numerical matrix of dimensions $n \times p$.
U	The estimated covariance matrix associated with the rows, a numerical matrix of dimensions $n \times n$.
V	The estimated covariance matrix associated with the columns, a numerical matrix of dimensions $p \times p$.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

https://en.wikipedia.org/wiki/Matrix_normal_distribution#Definition

Pocuca N., Gallaugher M. P., Clark K. M. & McNicholas P. D. (2019). Assessing and Visualizing Matrix Variate Normality. arXiv:1910.02859.

See Also

dmn, rmn, ddplot

Examples

```
M <- as.matrix(iris[1:8, 1:4])
U <- cov( matrix( rnorm(100 * 8), ncol = 8 ) )
V <- cov( iris[1:50, 1:4] )
X <- rmn(200, M, U, V)
mod <- mn.mle(X)
```

`Random matrices simulation from the matrix normal distribution`
Random matrices simulation from the matrix normal distribution

---

Description

Random matrices simulation from the matrix normal distribution.

Usage

```
rmn(k, M, U, V)
```

Arguments

k	The sample size, the number of matrices to simulate.
M	The mean matrix of the distribution, a numerical matrix of dimensions $n \times p$.
U	The covariance matrix associated with the rows, a numerical matrix of dimensions $n \times n$.
V	The covariance matrix associated with the columns, a numerical matrix of dimensions $p \times p$.

Value

A list with k elements, k matrices of dimension $n\ timesp$ each. These are the random matrices drawn from a matrix normal distribution.

Author(s)

Michail Tsagris.

R implementation and documentation: Michail Tsagris <mtsagris@uoc.gr>.

References

https://en.wikipedia.org/wiki/Matrix_normal_distribution#Definition

See Also

dmn, mn.mle, ddplot

Examples

```
M <- as.matrix(iris[1:8, 1:4])
U <- cov( matrix( rnorm(100 * 8), ncol = 8 ) )
V <- cov( iris[1:50, 1:4] )
X <- rmn(10, M, U, V)
```

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