

# Package ‘rWishart’

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**Title** Random Wishart Matrix Generation

**Version** 0.1.2

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**Description** An expansion of R's 'stats' random wishart matrix generation.

This package allows the user to generate singular, Uhlig and Harald (1994) <[doi:10.1214/aos/1176325375](https://doi.org/10.1214/aos/1176325375)>, and pseudo wishart, Diaz-Garcia, et al.(1997) <[doi:10.1006/jmva.1997.1689](https://doi.org/10.1006/jmva.1997.1689)>, matrices. In addition the user can generate wishart matrices with fractional degrees of freedom, Adhikari (2008) <[doi:10.1061/\(ASCE\)0733-9399\(2008\)134:12\(1029\)](https://doi.org/10.1061/(ASCE)0733-9399(2008)134:12(1029))>, commonly used in volatility modeling. Users can also use this package to create random covariance matrices.

**Depends** R (>= 3.3)

**Imports** Matrix, MASS, stats, lazyeval

**License** GPL-2

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**Suggests** covr, knitr, rmarkdown, testthat

**URL** <https://rwishart.bearstatistics.com>

**NeedsCompilation** no

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**Repository** CRAN

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rFractionalWishart      *Random Fractional Wishart Matrix*

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### Description

Generate n random matrices, distributed according to the Wishart distribution with parameters Sigma and df,  $W_p(\text{Sigma}, \text{df})$ .

### Usage

```
rFractionalWishart(n, df, Sigma, covariance = FALSE,
  simplify = "array")
```

### Arguments

n	integer: the number of replications.
df	numeric parameter, “degrees of freedom”.
Sigma	positive definite ( $p \times p$ ) “scale” matrix, the matrix parameter of the distribution.
covariance	logical on whether a covariance matrix should be generated
simplify	logical or character string; should the result be simplified to a vector, matrix or higher dimensional array if possible? For sapply it must be named and not abbreviated. The default value, TRUE, returns a vector or matrix if appropriate, whereas if simplify = “array” the result may be an <a href="#">array</a> of “rank” ( $=\text{length}(\text{dim}(.))$ ) one higher than the result of $\text{FUN}(X[[i]])$ .

### Details

If  $X_1, \dots, X_m$  is a sample of m independent multivariate Gaussians with mean vector 0, and covariance matrix Sigma, the distribution of  $M = X'X$  is  $W_p(\text{Sigma}, m)$ .

### Value

A numeric array of dimension  $p * p * n$ , where each array is a positive semidefinite matrix, a realization of the Wishart distribution  $W_p(\text{Sigma}, \text{df})$

### References

Adhikari, S. (2008). Wishart random matrices in probabilistic structural mechanics. *Journal of engineering mechanics*, 134(12), doi: [10.1061/\(ASCE\)07339399\(2008\)134:12\(1029\)](https://doi.org/10.1061/(ASCE)07339399(2008)134:12(1029)).

### Examples

```
rFractionalWishart(2, 22.5, diag(1, 20))
```

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rNonsingularWishart     *Random Nonsingular Wishart Matrix*

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### Description

Generate n random matrices, distributed according to the Wishart distribution with parameters Sigma and df,  $W_p(\text{Sigma}, \text{df})$ .

### Usage

```
rNonsingularWishart(n, df, Sigma, covariance = FALSE,
  simplify = "array")
```

### Arguments

n	integer: the number of replications.
df	numeric parameter, “degrees of freedom”.
Sigma	positive definite ( $p \times p$ ) “scale” matrix, the matrix parameter of the distribution.
covariance	logical on whether a covariance matrix should be generated
simplify	logical or character string; should the result be simplified to a vector, matrix or higher dimensional array if possible? For simplify it must be named and not abbreviated. The default value, TRUE, returns a vector or matrix if appropriate, whereas if simplify = “array” the result may be an <a href="#">array</a> of “rank” ( $=\text{length}(\text{dim}(\cdot))$ ) one higher than the result of $\text{FUN}(X[[i]])$ .

### Details

If  $X_1, \dots, X_m$  is a sample of m independent multivariate Gaussians with mean vector 0, and covariance matrix Sigma, the distribution of  $M = X'X$  is  $W_p(\text{Sigma}, m)$ .

### Value

A numeric array of dimension  $p * p * n$ , where each array is a positive semidefinite matrix, a realization of the Wishart distribution  $W_p(\text{Sigma}, \text{df})$

### Examples

```
rNonsingularWishart(2, 20, diag(1, 5))
```

---

rPseudoWishart      *Random Psuedo Wishart Matrix*

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### Description

Generate  $n$  random matrices, distributed according to the Wishart distribution with parameters  $\Sigma$  and  $df$ ,  $W_p(\Sigma, df)$ .

### Usage

```
rPseudoWishart(n, df, Sigma, covariance = FALSE, simplify = "array")
```

### Arguments

n	integer: the number of replications.
df	numeric parameter, “degrees of freedom”.
Sigma	positive definite ( $p \times p$ ) “scale” matrix, the matrix parameter of the distribution.
covariance	logical on whether a covariance matrix should be generated
simplify	logical or character string; should the result be simplified to a vector, matrix or higher dimensional array if possible? For simplify it must be named and not abbreviated. The default value, TRUE, returns a vector or matrix if appropriate, whereas if simplify = “array” the result may be an <a href="#">array</a> of “rank” ( $=\text{length}(\text{dim}(.))$ ) one higher than the result of $\text{FUN}(X[[i]])$ .

### Details

If  $X_1, \dots, X_m$  is a sample of  $m$  independent multivariate Gaussians with mean vector 0, and covariance matrix  $\Sigma$ , the distribution of  $M = X'X$  is  $W_p(\Sigma, m)$ .

### Value

A numeric array of dimension  $p * p * n$ , where each array is a positive semidefinite matrix, a realization of the Wishart distribution  $W_p(\Sigma, df)$

### References

Diaz-Garcia, Jose A, Ramon Gutierrez Jaimez, and Kanti V Mardia. 1997. “Wishart and Pseudo-Wishart Distributions and Some Applications to Shape Theory.” *Journal of Multivariate Analysis* 63 (1): 73–87. doi:10.1006/jmva.1997.1689.

### Examples

```
rPseudoWishart(2, 5, diag(1, 20))
```

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rSingularWishart	<i>Random Singular Wishart Matrix</i>
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**Description**

Generate  $n$  random matrices, distributed according to the Wishart distribution with parameters  $\Sigma$  and  $df$ ,  $W_p(\Sigma, df)$ .

**Usage**

```
rSingularWishart(n, df, Sigma, covariance = FALSE, simplify = "array")
```

**Arguments**

n	integer: the number of replications.
df	numeric parameter, “degrees of freedom”.
Sigma	positive definite ( $p \times p$ ) “scale” matrix, the matrix parameter of the distribution.
covariance	logical on whether a covariance matrix should be generated
simplify	logical or character string; should the result be simplified to a vector, matrix or higher dimensional array if possible? For simplify it must be named and not abbreviated. The default value, TRUE, returns a vector or matrix if appropriate, whereas if simplify = “array” the result may be an <a href="#">array</a> of “rank” ( $=\text{length}(\text{dim}(.))$ ) one higher than the result of $\text{FUN}(X[[i]])$ .

**Details**

If  $X_1, \dots, X_m$  is a sample of  $m$  independent multivariate Gaussians with mean vector 0, and covariance matrix  $\Sigma$ , the distribution of  $M = X'X$  is  $W_p(\Sigma, m)$ .

**Value**

A numeric array of dimension  $p * p * n$ , where each array is a positive semidefinite matrix, a realization of the Wishart distribution  $W_p(\Sigma, df)$

**References**

Uhlig, Harald. 1994. “On Singular Wishart and Singular Multivariate Beta Distributions.” *The Annals of Statistics* 22 (1): 395–405. doi:10.1214/aos/1176325375.

**Examples**

```
rSingularWishart(2, 5, diag(1, 20))
```

**Description**

An expansion of R's 'stats' random wishart matrix generation. This package allows the user to generate singular, Uhlig and Harald (1994) <doi:10.1214/aos/1176325375>, and pseudo wishart, Diaz-Garcia, et al.(1997) <doi:10.1006/jmva.1997.1689>, matrices. In addition the user can generate wishart matrices with fractional degrees of freedom, Adhikari (2008) <doi:10.1061/(ASCE)0733-9399(2008)134:12(1029)>, commonly used in volatility modeling. Users can also use this package to create random covariance matrices.

Generate n random matrices, distributed according to the Wishart distribution with parameters Sigma and df,  $W_p(\text{Sigma}, \text{df})$ .

**Usage**

```
rWishart(n, df, Sigma, covariance = FALSE, simplify = "array")
```

**Arguments**

n	integer: the number of replications.
df	numeric parameter, "degrees of freedom".
Sigma	positive definite ( $p \times p$ ) "scale" matrix, the matrix parameter of the distribution.
covariance	logical on whether a covariance matrix should be generated
simplify	logical or character string; should the result be simplified to a vector, matrix or higher dimensional array if possible? For simplify it must be named and not abbreviated. The default value, TRUE, returns a vector or matrix if appropriate, whereas if simplify = "array" the result may be an <a href="#">array</a> of "rank" ( $=\text{length}(\text{dim}(.))$ ) one higher than the result of $\text{FUN}(X[[i]])$ .

**Details**

If  $X_1, \dots, X_m$  is a sample of m independent multivariate Gaussians with mean vector 0, and covariance matrix Sigma, the distribution of  $M = X'X$  is  $W_p(\text{Sigma}, m)$ .

**Value**

A numeric array of dimension  $p * p * n$ , where each array is a positive semidefinite matrix, a realization of the Wishart distribution  $W_p(\text{Sigma}, \text{df})$

**Examples**

```
rWishart(2, 5, diag(1, 20))
```

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wishartTest	<i>Test if Matrix is a Wishart Matrix</i>
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**Description**

Given a random Wishart matrix,  $B$ , from  $W_p(\text{Sigma}, \text{df})$  and independent random vector  $a$ , then  $(a' B a) / (a' \text{Sigma} a)$  is chi-squared with  $\text{df}$  degrees of freedom.

**Usage**

```
wishartTest(WishMat, Sigma, vec = NULL)
```

**Arguments**

WishMat	random Wishart Matrix from $W_p(\text{Sigma}, \text{df})$
Sigma	Covariance matrix for $W_p(\text{Sigma}, \text{df})$
vec	independent random vector

**Value**

A chi-squared random variable with  $\text{df}$  degrees of freedom.

**Examples**

```
wishartTest(rWishart(1, 5, diag(1, 20), simplify = FALSE)[[1]], diag(1, 20))
```

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