# Package 'MWright'

May 7, 2026

**Type** Package

**Title** Mainardi-Wright Family of Distributions

**Version** 0.3.2

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**Maintainer** Dexter Cahoy <cahoyd@uhd.edu>

**Description** Implements random number generation, plotting, and estimation algorithms for the two-parameter one-sided and two-sided M-Wright (Mainardi-Wright) family.
The M-Wright distributions naturally generalize the widely used one-sided (Airy and half-normal or half-Gaussian) and symmetric (Airy and Gaussian or normal) models.
These are widely studied in time-fractional differential equations. References: Cahoy and Minkabo (2017) <doi:10.3233/MAS-170388>; Cahoy (2012) <doi:10.1007/s00180-011-0269-x>; Cahoy (2012) <doi:10.1080/03610926.2010.543299>; Cahoy (2011); Mainardi, Mura, and Pagnini (2010) <doi:10.1155/2010/104505>.

**License** GPL (>= 3)

**Encoding** UTF-8

**LazyData** true

**Imports** stats, cubature

**RoxygenNote** 6.1.1

**NeedsCompilation** no

**Repository** CRAN

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## Contents

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`dmwright1` *One-sided M-Wright distribution*

---

## Description

Plots the density function.

## Usage

```
dmwright1(ah, sh, m, max)
```

## Arguments

| | |
|---|---|
| `ah` | point estimate for shape parameter alpha. |
| `sh` | point estimate for scale parameter s. |
| `m` | number of data points (pairs) to use for plotting. |
| `max` | maximum x-axis value to use for plotting. |

## Value

numeric matrix

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
xy=dmwright1(0.45, 2.5, 1000, 10)
plot(xy[,1], xy[,2],  lwd = 2, type="l",ylab="", xlab="x")

mwright1_sided <- rmwright1(1000, 0.45, 2.5)
hist(mwright1_sided, br=30, prob=TRUE)
lines(xy[,1], xy[,2],  lwd=2 )
```

---

`dmwright2` *Two-sided M-Wright distribution*

---

## Description

Plots the density function.

## Usage

```
dmwright2(ah, sh, m, max)
```

## Arguments

| | |
|---|---|
| `ah` | point estimate for shape parameter alpha. |
| `sh` | point estimate for scale parameter s. |
| `m` | number of data points (pairs) to use for plotting. |
| `max` | maximum x-axis value to use for plotting. |

## Value

numeric matrix

## References


Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
xy=dmwright2(0.45, 2.5, 1000, 10)
plot(xy[,1], xy[,2],  lwd = 2, type="l",ylab="", xlab="x")

mwright2_sided <- rmwright2(1000, 0.45, 2.5)
hist(mwright2_sided, br=30, prob=TRUE)
lines(xy[,1], xy[,2],  lwd=2 )
```

---

`int_est1` *Interval estimation for one-sided M-Wright distribution*

---

## Description

Confidence intervals for the model parameters.

## Usage

```
int_est1(x, lev)
```

## Arguments

| | |
|---|---|
| `x` | numeric vector |
| `lev` | confidence level. |

## Value

matrix

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
mwright_1sided <- rmwright1(1000, 0.7, 0.4)
int_est1(mwright_1sided ,0.95)
```

---

`int_est2` *Interval estimation for two-sided M-Wright distribution*

---

## Description

Confidence intervals for the model parameters.

## Usage

```
int_est2(x, lev)
```

## Arguments

| | |
|---|---|
| `x` | numeric vector |
| `lev` | confidence level. |

## Value

matrix

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

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## Examples

```
mwright_2sided <- rmwright2(1000, 0.7, 0.4)
int_est2(mwright_2sided ,0.95)
```

MWright *MWright Package*

## Description

Contains random number generation, plotting, and estimation algorithms for the two-parameter one-sided and two-sided M-Wright (Mainardi-Wright) family. The M-Wright distributions naturally generalize widely used one-sided (Airy and half-normal or half-normal) and symmetric (Airy and Gaussian or normal) models. These are widely studied in time-fractional diffusion processes.

## Details

References:

Cahoy and Minkabo (2017)<doi:10.3233/MAS-170388>

Cahoy (2012) <doi:10.1007/s00180-011-0269-x>

Cahoy (2012) <doi:10.1080/03610926.2010.543299>

Cahoy (2011)

Mainardi, Mura, and Pagnini (2010) <doi:10.1155/2010/104505>

## Author(s)

Dexter Cahoy <cahoyd@uhd.edu>

pmwright1 *Distribution function for one-sided M-Wright distribution*

## Description

Calculates a left-tail probability.

## Usage

```
pmwright1(alp, sc, upper)
```

## Arguments

| | |
|---|---|
| alp | point estimate for shape parameter alpha. |
| sc | point estimate for scale parameter s. |
| upper | non-negative upper quantile |

## Value

numeric

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
pmwright1(runif(1), runif(1,0,10),Inf  )

pmwright1(runif(1), runif(1,0,10), 0.5 )
```

---

`pmwright2` *Distribution function for two-sided M-Wright distribution*

---

## Description

Calculates a left-tail probability.

## Usage

```
pmwright2(alp, sc, upper)
```

## Arguments

| | |
|---|---|
| `alp` | point estimate for shape parameter alpha. |
| `sc` | point estimate for scale parameter s. |
| `upper` | upper quantile |

## Value

numeric

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
pmwright2(runif(1), runif(1,0,10),  Inf )

pmwright2(runif(1), runif(1,0,10), 0.5 )
```

---

`point_est1` *Point estimation for one-sided M-Wright distribution*

---

## Description

This provides point estimates for the shape and scale parameters.

## Usage

```
point_est1(x)
```

## Arguments

| | |
|---|---|
| `x` | numeric vector. |

## Value

numeric vector

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
x <- rmwright1(1000, 0.7, 0.4)
point_est1(x)
```

---

`point_est2` *Point estimates for two-sided M-Wright distribution*

---

## Description

This provides point estimates for the shape and scale parameters.

## Usage

```
point_est2(x)
```

## Arguments

| | |
|---|---|
| x | numeric vector. |

## Value

numeric vector

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
x <- rmwright2(1000, 0.7, 0.4)
point_est2(x)
```

---

`rmwright1` *Random number generation for one-sided M-Wright distribution*

---

## Description

Generates random numbers.

## Usage

```
rmwright1(n, nu, sc)
```

## Arguments

| | |
|---|---|
| `n` | sample size. |
| `nu` | a number between 0 and 1. |
| `sc` | a non-negative scale value. |

## Value

a vector of one-sided M-Wright distributed random numbers

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoy (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
mwright_1sided <- rmwright1(1000, 0.7, 0.4)
hist(mwright_1sided, br=30)
```

---

`rmwright2` *Random number generation for two-sided M-Wright distribution*

---

## Description

Generates random numbers.

## Usage

```
rmwright2(n, nu, sc)
```

## Arguments

| | |
|---|---|
| `n` | sample size. |
| `nu` | a number between 0 and 1. |
| `sc` | a non-negative scale value. |

## Value

a vector of two-sided M-Wright distributed random numbers.

## References

Cahoy and Minkabo (2017). *Inference for three-parameter M-Wright distributions with applications.* Model Assisted Statistics and Applications, 12(2), 115-125. https://doi.org/10.3233/MAS-170388

Cahoy (2012). *Moment estimators for the two-parameter M-Wright distribution.* Computational Statistics, 27(3), 487-497. https://doi.org/10.1007/s00180-011-0269-x

Cahoy (2012). *Estimation and simulation for the M-Wright function.* Communications in Statistics-Theory and Methods, 41(8), 1466-1477. https://doi.org/10.1080/03610926.2010.543299

Cahoyd (2011). *On the parameterization of the M-Wright function.* Far East Journal of Theoretical Statistics, 34(2), 155-164. http://www.pphmj.com/abstract/5767.htm

Mainardi, Mura, and Pagnini (2010). *The M-Wright Function in Time-Fractional Diffusion Processes: A Tutorial Survey*. Int. J. Differ. Equ., Volume 2010. https://doi.org/10.1155/2010/104505

## Examples

```
mwright_2sided <- rmwright2(1000, 0.7, 0.4)
hist(mwright_2sided, br=30)
```

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