

# Package ‘lamW’

March 1, 2023

**Type** Package

**Title** Lambert-W Function

**Version** 2.1.2

**Date** 2023-02-28

**Description** Implements both real-valued branches of the Lambert-W function (Corless et al, 1996) <[doi:10.1007/BF02124750](https://doi.org/10.1007/BF02124750)> without the need for installing the entire GSL.

**License** BSD\_2\_clause + file LICENSE

**Imports** Rcpp, RcppParallel

**LinkingTo** Rcpp, RcppParallel

**SystemRequirements** GNU make

**Suggests** covr, tinytest

**NeedsCompilation** yes

**URL** <https://github.com/aadler/lamW>

**BugReports** <https://github.com/aadler/lamW/issues>

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**Repository** CRAN

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### Description

Implements both real-valued branches of the Lambert-W function (Corless et al, 1996) <doi:10.1007/BF02124750> without the need for installing the entire GSL.

### Details

The DESCRIPTION file:

```
Package:          lamW
Type:            Package
Title:          Lambert-W Function
Version:        2.1.2
Date:          2023-02-28
Authors@R:     c(person(given="Avraham", family="Adler",role=c("aut", "cph", "cre"), email="Avraham.Adler@gmail.com"))
Description:    Implements both real-valued branches of the Lambert-W function (Corless et al, 1996) <doi:10.1007/BF02124750>
License:       BSD_2_clause + file LICENSE
Imports:       Rcpp, RcppParallel
LinkingTo:     Rcpp, RcppParallel
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Suggests:     covr, tinytest
NeedsCompilation: yes
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Author:       Avraham Adler [aut, cph, cre] (<https://orcid.org/0000-0002-3039-0703>)
Maintainer:   Avraham Adler <Avraham.Adler@gmail.com>
Archs:        x64
```

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### Author(s)

NA Maintainer: NA

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**Description**

The Lambert-W function is defined as the multivalued inverse of the function  $z = f(W) = We^W$ . The function has two branches. The principal branch is defined on the interval  $[-\frac{1}{e}, \infty)$  and is always greater than or equal to  $-1$ . The second branch is defined on the interval  $[-\frac{1}{e}, 0)$  and is always less than or equal to  $-1$ . The real-valued function is not defined for values less than  $-\frac{1}{e}$ .

**Usage**

```
lambertW0(x)
lambertWm1(x)
```

**Arguments**

x                    **numeric** vector of values

**Details**

The Lambert-W function is defined for all real  $x \geq -\frac{1}{e}$ . It has two values in the interval  $(-\frac{1}{e}, 0)$ . The values strictly greater than  $-1$  are assigned to the “principal” branch, also referred to as  $W_0$ , and the values strictly less than  $-1$  are assigned to the “secondary” branch, referred to as  $W_{-1}$ . For non-negative  $x$ , only the principal branch exists as the other real-valued branch approaches negative infinity as  $x$  approaches 0. The algorithms used to calculate the values predominantly follow those in the reference with some simplifications. There are many applications in which the Lambert-W function is useful, such as combinatorics, physics, and hydrology. The interested reader is directed to the references for more detail.

**Value**

Both functions return the appropriate values in the intervals for which they are defined. Outside of those intervals, they will return NaN, except that `lambertW0(Inf)` will return its limit Inf and `lambertWm1(0)` will return its limit -Inf.

**Author(s)**

Avraham Adler <Avraham.Adler@gmail.com>

**References**

Corless, R. M., Gonnet, G. H., Hare, D. E., Jeffrey, D. J., Knuth, D. E. 1996 "On the Lambert W function", *Advances in Computational Mathematics*, **5**, 329–359, Springer <doi:10.1007/BF02124750>

Fritsch, F. N.; Shafer, R. E. & Crowley, W. P. 1973 "Solution of the transcendental equation ( $we^w = x$ )", *Communications of the ACM*, **16**, 123–124, Association for Computing Machinery (ACM) <doi:10.1145/361952.361970>

**See Also**

This package provides similar functionality to the `Lambert` functions in the `gsl` package without having to obtain or install the entire GSL.

**Examples**

```
lambertW0(exp(1))    ## Should equal 1, as 1 * exp(1) = e.  
lambertW0(0)        ## Should equal 0, as 0 * exp(0) = 0.  
lambertW0(-exp(-1)) ## Should equal -1.  
lambertWm1(-exp(-1)) ## Should also equal -1.  
A <- -2 * exp(-2)  
lambertWm1(A)       ## Should equal -2
```

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