

NAG Library Routine Document

A02AAF

Note: before using this routine, please read the Users' Note for your implementation to check the interpretation of *bold italicised* terms and other implementation-dependent details.

1 Purpose

A02AAF evaluates the square root of the complex number $x = (x_r, x_i)$.

2 Specification

```
SUBROUTINE A02AAF (XR, XI, YR, YI)
REAL (KIND=nag_wp) XR, XI, YR, YI
```

3 Description

The method of evaluating $y = \sqrt{x}$ depends on the value of x_r .

For $x_r \geq 0$,

$$y_r = \sqrt{\frac{x_r + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_i = \frac{x_i}{2y_r}.$$

For $x_r < 0$,

$$y_i = \text{sign}(x_i) \times \sqrt{\frac{|x_r| + \sqrt{x_r^2 + x_i^2}}{2}}, \quad y_r = \frac{x_i}{2y_i}.$$

Overflow is avoided when squaring x_i and x_r by calling A02ABF to evaluate $\sqrt{x_r^2 + x_i^2}$.

4 References

Wilkinson J H and Reinsch C (1971) *Handbook for Automatic Computation II, Linear Algebra* Springer-Verlag

5 Parameters

- | | | |
|----|--|---------------|
| 1: | XR – REAL (KIND=nag_wp) | <i>Input</i> |
| 2: | XI – REAL (KIND=nag_wp) | <i>Input</i> |
| | <i>On entry:</i> x_r and x_i , the real and imaginary parts of x , respectively. | |
| 3: | YR – REAL (KIND=nag_wp) | <i>Output</i> |
| 4: | YI – REAL (KIND=nag_wp) | <i>Output</i> |
| | <i>On exit:</i> y_r and y_i , the real and imaginary parts of y , respectively. | |

6 Error Indicators and Warnings

None.

7 Accuracy

The result should be correct to *machine precision*.

8 Parallelism and Performance

Not applicable.

9 Further Comments

The time taken by A02AAF is negligible.

10 Example

This example finds the square root of $-1.7 + 2.6i$.

10.1 Program Text

```

Program a02aafe

!      A02AAF Example Program Text
!
!      Mark 25 Release. NAG Copyright 2014.
!
!      .. Use Statements ..
!      Use nag_library, Only: a02aaf, nag_wp
!      .. Implicit None Statement ..
!      Implicit None
!      .. Parameters ..
!      Integer, Parameter          :: nin = 5, nout = 6
!      .. Local Scalars ..
!      Real (Kind=nag_wp)         :: xi, xr, yi, yr
!      .. Executable Statements ..
!      Write (nout,*) 'A02AAF Example Program Results'

!      Skip heading in data file
!      Read (nin,*)

!      Read (nin,*) xr, xi

!      Compute square root of (XR,XI) and return in (YR,YI)

!      Call a02aaf(xr,xi,yr,yi)

!      Write (nout,*)
!      Write (nout,*) '   XR   XI   YR   YI'
!      Write (nout,99999) xr, xi, yr, yi

99999 Format (1X,2F6.1,2F9.4)
End Program a02aafe

```

10.2 Program Data

```

A02AAF Example Program Data
-1.7 2.6

```

10.3 Program Results

```

A02AAF Example Program Results

```

```

   XR   XI   YR   YI
-1.7   2.6  0.8386  1.5502

```
