

# 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)

*Input*

2: XI – REAL (KIND=nag\_wp)

*Input*

*On entry:*  $x_r$  and  $x_i$ , the real and imaginary parts of  $x$ , respectively.

3: YR – REAL (KIND=nag\_wp)

*Output*

4: YI – REAL (KIND=nag\_wp)

*Output*

*On exit:*  $y_r$  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 Further Comments

The time taken by A02AAF is negligible.

## 9 Example

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

### 9.1 Program Text

```

Program a02aafe

!      A02AAF Example Program Text
!
!      Mark 24 Release. NAG Copyright 2012.
!
!      .. 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

```

### 9.2 Program Data

```

A02AAF Example Program Data
-1.7 2.6

```

### 9.3 Program Results

```

A02AAF Example Program Results

```

```

   XR   XI   YR   YI
-1.7   2.6   0.8386  1.5502

```

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