

NAG Fortran 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 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 – <i>real</i>	<i>Input</i>
2:	XI – <i>real</i>	<i>Input</i>

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

3:	YR – <i>real</i>	<i>Output</i>
4:	YI – <i>real</i>	<i>Output</i>

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 the routine is negligible.

9 Example

To find the square root of $-1.7 + 2.6i$.

9.1 Program Text

```
*      A02AAF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
*      .. Local Scalars ..
      real             XI, XR, YI, YR
*      .. External Subroutines ..
      EXTERNAL          A02AAF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'A02AAF Example Program Results'
*      Skip heading in data file
      READ (NIN,*)
      READ (NIN,*) XR, XI
*
      CALL A02AAF(XR,XI,YR,YI)
*
      WRITE (NOUT,*)
      WRITE (NOUT,*) '      XR      XI      YR      YI'
      WRITE (NOUT,99999) XR, XI, YR, YI
      STOP
*
99999  FORMAT (1X,2F6.1,2F9.4)
      END
```

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
```
