

# NAG Library Routine Document

## X04CAF

**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

X04CAF is an easy-to-use routine to print a real matrix stored in a two-dimensional array.

### 2 Specification

```
SUBROUTINE X04CAF(MATRIX, DIAG, M, N, A, LDA, TITLE, IFAIL)
INTEGER          M, N, LDA, IFAIL
double precision A(LDA,*)
CHARACTER*(*)    TITLE
CHARACTER*1      MATRIX, DIAG
```

### 3 Description

X04CAF prints a *double precision* matrix. It is an easy-to-use driver for X04CBF. The routine uses default values for the format in which numbers are printed, for labelling the rows and columns, and for output record length.

X04CAF will choose a format code such that numbers will be printed with an F8.4, an F11.4 or a 1PE13.4 format. The F8.4 code is chosen if the sizes of all the matrix elements to be printed lie between 0.001 and 1.0. The F11.4 code is chosen if the sizes of all the matrix elements to be printed lie between 0.001 and 9999.9999. Otherwise the 1PE13.4 code is chosen.

The matrix is printed with integer row and column labels, and with a maximum record length of 80.

The matrix is output to the unit defined by X04ABF.

### 4 References

None.

### 5 Parameters

1: MATRIX – CHARACTER\*1 *Input*

*On entry:* indicates the part of the matrix to be printed.

MATRIX = 'G'

The whole of the rectangular matrix.

MATRIX = 'L'

The lower triangle of the matrix, or the lower trapezium if the matrix has more rows than columns.

MATRIX = 'U'

The upper triangle of the matrix, or the upper trapezium if the matrix has more columns than rows.

*Constraint:* MATRIX = 'G', 'L' or 'U'.

- 2:   DIAG – CHARACTER\*1 *Input*  
*On entry:* unless MATRIX = 'G', DIAG must specify whether the diagonal elements of the matrix are to be printed.  
 DIAG = 'B'  
       The diagonal elements of the matrix are not referenced and not printed.  
 DIAG = 'U'  
       The diagonal elements of the matrix are not referenced, but are assumed all to be unity, and are printed as such.  
 DIAG = 'N'  
       The diagonal elements of the matrix are referenced and printed.  
 If MATRIX = 'G', then DIAG need not be set.  
*Constraint:* if MATRIX  $\neq$  'G', DIAG = 'B', 'U' or 'N'.
- 3:   M – INTEGER *Input*  
 4:   N – INTEGER *Input*  
*On entry:* the number of rows and columns of the band matrix, respectively, to be printed.  
 If either M or N is less than 1, X04CAF will exit immediately after printing TITLE; no row or column labels are printed.
- 5:   A(LDA,\*) – *double precision* array *Input*  
**Note:** the second dimension of the array A must be at least  $\max(1, N)$ .  
*On entry:* the matrix to be printed. Only the elements that will be referred to, as specified by parameters MATRIX and DIAG, need be set.
- 6:   LDA – INTEGER *Input*  
*On entry:* the first dimension of the array A as declared in the (sub)program from which X04CAF is called.  
*Constraint:*  $LDA \geq \max(1, M)$ .
- 7:   TITLE – CHARACTER\*(\*) *Input*  
*On entry:* a title to be printed above the matrix.  
 If TITLE = ' ', no title (and no blank line) will be printed.  
 If TITLE contains more than 80 characters, the contents of TITLE will be wrapped onto more than one line, with the break after 80 characters.  
 Any trailing blank characters in TITLE are ignored.
- 8:   IFAIL – INTEGER *Input/Output*  
*On entry:* IFAIL must be set to 0, -1 or 1. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.  
*On exit:* IFAIL = 0 unless the routine detects an error (see Section 6).  
 For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, if you are not familiar with this parameter, the recommended value is 0. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

## 6 Error Indicators and Warnings

If on entry  $IFAIL = 0$  or  $-1$ , explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

$IFAIL = 1$

On entry,  $MATRIX \neq 'G', 'L'$  or  $'U'$ .

$IFAIL = 2$

On entry,  $MATRIX = 'L'$  or  $'U'$ , but  $DIAG \neq 'N', 'U'$  or  $'B'$ .

$IFAIL = 3$

On entry,  $LDA < M$ .

## 7 Accuracy

Not applicable.

## 8 Further Comments

A call to X04CAF is equivalent to a call to X04CBF with the following argument values:

```

NCOLS = 80
INDENT = 0
LABROW = 'I'
LABCOL = 'I'
FORM = ' '
```

## 9 Example

This example program calls X04CAF twice, first to print a 3 by 5 rectangular matrix, and then to print a 5 by 5 lower triangular matrix.

### 9.1 Program Text

```

*      X04CAF Example Program Text
*      Mark 14 Release. NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
      INTEGER          NMAX, LDA
      PARAMETER        (NMAX=5,LDA=NMAX)
*      .. Local Scalars ..
      INTEGER          I, IFAIL, J
*      .. Local Arrays ..
      DOUBLE PRECISION A(LDA,NMAX)
*      .. External Subroutines ..
      EXTERNAL         X04CAF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'X04CAF Example Program Results'
      WRITE (NOUT,*)
*      Generate an array of data
      DO 40 J = 1, NMAX
         DO 20 I = 1, LDA
            A(I,J) = 10*I + J
         20 CONTINUE
      40 CONTINUE
*
*      IFAIL = 0
*
*      Print 3 by 5 rectangular matrix
```

```
CALL X04CAF('General',' ',3,5,A,LDA,'Example 1:',IFAIL)
*
WRITE (NOUT,*)
*
Print 5 by 5 lower triangular matrix
CALL X04CAF('Lower','Non-unit',5,5,A,LDA,'Example 2:',IFAIL)
*
END
```

## 9.2 Program Data

None.

## 9.3 Program Results

X04CAF Example Program Results

Example 1:

|   | 1       | 2       | 3       | 4       | 5       |
|---|---------|---------|---------|---------|---------|
| 1 | 11.0000 | 12.0000 | 13.0000 | 14.0000 | 15.0000 |
| 2 | 21.0000 | 22.0000 | 23.0000 | 24.0000 | 25.0000 |
| 3 | 31.0000 | 32.0000 | 33.0000 | 34.0000 | 35.0000 |

Example 2:

|   | 1       | 2       | 3       | 4       | 5       |
|---|---------|---------|---------|---------|---------|
| 1 | 11.0000 |         |         |         |         |
| 2 | 21.0000 | 22.0000 |         |         |         |
| 3 | 31.0000 | 32.0000 | 33.0000 |         |         |
| 4 | 41.0000 | 42.0000 | 43.0000 | 44.0000 |         |
| 5 | 51.0000 | 52.0000 | 53.0000 | 54.0000 | 55.0000 |

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