NAG Fortran Library Routine Document

X04DEF

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

X04DEF is an easy-to-use routine to print a ***complex*** band matrix stored in a packed two-dimensional array.

2 Specification

```
SUBROUTINE X04DEF(M, N, KL, KU, A, LDA, TITLE, IFAIL)
INTEGER           M, N, KL, KU, LDA, IFAIL
complex           A(LDA,*)
CHARACTER*(*)     TITLE
```

3 Description

X04DEF prints a ***complex*** band matrix stored in a packed two-dimensional array. It is an easy-to-use driver for X04DFF. The routine uses default values for the format in which numbers are printed, for labelling the rows and columns, and for output record length.

X04DEF 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 chosen code is used to print each complex element of the matrix with the real part above the imaginary part.

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: M – INTEGER *Input*

2: 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, X04DEF will exit immediately after printing TITLE; no row or column labels are printed.

3: KL – INTEGER *Input*

On entry: the number of sub-diagonals of the band matrix A.

Constraint: KL ≥ 0.

4: KU – INTEGER *Input*

On entry: the number of super-diagonals of the band matrix A.

Constraint: KU ≥ 0.

5: A(LDA,*) – ***complex*** array *Input*

Note: the second dimension of the array A=1,min("x(82)=1,min("x(82)must be at least max(1,min(M+KU,N)).

On entry: the band matrix to be printed. The leading $(\mathrm{KL}+\mathrm{KU}+1)$ by $\min(\mathrm{M}+\mathrm{KU},\mathrm{N})$ part of array A must contain band elements of the matrix, packed column by column, with the leading diagonal of the matrix in row $(\mathrm{KU}+1)$ of the array, the first super-diagonal starting at position 2 in row KU, the first sub-diagonal starting at position 1 in row $(\mathrm{KU}+2)$, and so on. Elements in the array A that do not correspond to elements in the band matrix (such as the top left KU by KU triangle) are not referenced, and need not be set.

6: LDA – INTEGER *Input*

On entry: the first dimension of the array A as declared in the (sub)program from which X04DEF is called.

Constraint: $\mathrm{LDA} \geq \mathrm{KL}+\mathrm{KU}+1$.

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. Users who are unfamiliar with this parameter should refer to Chapter P01 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, for users 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, $\mathrm{KL} < 0$.

IFAIL $= 2$

On entry, $\mathrm{KU} < 0$.

IFAIL $= 3$

On entry, $\mathrm{LDA} < \mathrm{KL}+\mathrm{KU}+1$.

7 Accuracy

Not applicable.

8 Further Comments

A call to X04DEF is equivalent to a call to X04DFF with the following argument values:

```
NCOLS = 80
INDENT = 0
LABROW = 'I'
LABCOL = 'I'
FORMAT = ' '
USEFRM = 'A'
```

9 Example

This example program calls X04DEF to print a 5 by 5 band matrix with one sub-diagonal and one super-diagonal.

9.1 Program Text

Note: the listing of the example program presented below uses ***bold italicised*** terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     X04DEF 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 ..
      real             AA
      INTEGER          I, IFAIL, J
*     .. Local Arrays ..
      complex          A(LDA,NMAX)
*     .. External Subroutines ..
      EXTERNAL         X04DEF
*     .. Intrinsic Functions ..
      INTRINSIC        cmplx
*     .. Executable Statements ..
      WRITE (NOUT,*) 'X04DEF Example Program Results'
      WRITE (NOUT,*)
*
*     Generate an array of data
      DO 40 J = 1, NMAX
         DO 20 I = 1, LDA
            AA = 10*I + J
            A(I,J) = cmplx(AA,-AA)
   20    CONTINUE
   40 CONTINUE
*
      IFAIL = 0
*
*     Print 5 by 5 band matrix with 1 sub-diagonal and 1 super-diagonal
      CALL X04DEF(5,5,1,1,A,LDA,'Band Matrix:',IFAIL)
*
      STOP
      END
```

9.2 Program Data

None.

9.3 Program Results

```
 X04DEF Example Program Results

 Band Matrix:
             1          2          3          4          5
 1     21.0000    12.0000
      -21.0000   -12.0000

 2     31.0000    22.0000    13.0000
      -31.0000   -22.0000   -13.0000

 3                32.0000    23.0000    14.0000
                 -32.0000   -23.0000   -14.0000

 4                           33.0000    24.0000    15.0000
                            -33.0000   -24.0000   -15.0000

 5                                      34.0000    25.0000
                                       -34.0000   -25.0000
```