NAG Fortran Library Routine Document

X04CFF

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

X04CFF prints a ***real*** band matrix stored in a packed two-dimensional array.

2 Specification

```
      SUBROUTINE X04CFF(M, N, KL, KU, A, LDA, FORMAT, TITLE, LABROW, RLABS,
     1                  LABCOL, CLABS, NCOLS, INDENT, IFAIL)
      INTEGER           M, N, KL, KU, LDA, NCOLS, INDENT, IFAIL
      real              A(LDA,*)
      CHARACTER*(*)     FORMAT, TITLE, RLABS(*), CLABS(*)
      CHARACTER*1       LABROW, LABCOL
```

3 Description

X04CFF prints a ***real*** band matrix stored in a packed two-dimensional array, using a format specifier supplied by the user. 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, X04CFF 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,*) – ***real*** array *Input*

Note: the second dimension of the array A must be at least $\max(1, \min(\mathrm{M} + \mathrm{KU}, \mathrm{N}))$.

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 X04CFF is called.

Constraint: LDA $\geq$ KL + KU + 1.

7: FORMAT – CHARACTER*(*) *Input*

On entry: a valid Fortran format code. This may be any format code allowed on the system, whether it is standard Fortran or not. FORMAT is used to print elements of the matrix A. It may or may not be enclosed in brackets. Examples of valid values for FORMAT are 'F11.4', '1PE13.5', 'G14.5'.

In addition, there are two special codes which force X04CFF to choose its own format code:

> FORMAT = ' ' means that X04CFF 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.
>
> FORMAT = '*' means that X04CFF will choose a format code such that numbers will be printed to as many significant digits as are necessary to distinguish between neighbouring machine numbers. Thus any two numbers that are stored with different internal representations should look different on output. Whether they do in fact look different will depend on the run-time library of the Fortran compiler in use.

Constraint: the character length of FORMAT must be ≤ 80.

8: 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 NCOLS characters, the contents of TITLE will be wrapped onto more than one line, with the break after NCOLS characters.

Any trailing blank characters in TITLE are ignored.

9: LABROW – CHARACTER*1 *Input*

On entry: indicates the type of labelling to be applied to the rows of the matrix, as follows:

> if LABROW = 'N', X04CFF prints no row labels;
>
> if LABROW = 'I', X04CFF prints integer row labels;
>
> if LABROW = 'C', X04CFF prints character labels, which must be supplied in array RLABS.

Constraint: LABROW = 'N', 'I' or 'C'.

10: RLABS($*$) – CHARACTER*(*) array *Input*

On entry: if LABROW = 'C', RLABS must be dimensioned at least of length M and must contain labels for the rows of the matrix, otherwise RLABS may be dimensioned of length 1.

Labels are right justified when output, in a field which is as wide as necessary to hold the longest row label. Note that this field width is subtracted from the number of usable columns, NCOLS.

11: LABCOL – CHARACTER*1 *Input*

On entry: indicates the type of labelling to be applied to the columns of the matrix, as follows:

if LABCOL = ’N’, X04CFF prints no column labels;

if LABCOL = ’I’, X04CFF prints integer column labels;

if LABCOL = ’C’, X04CFF prints character labels, which must be supplied in array CLABS.

Constraint: LABCOL = ’N’, ’I’, or ’C’.

12: CLABS($*$) – CHARACTER*(*) array *Input*

On entry: if LABCOL = ’C’, CLABS must be dimensioned at least of length N and must contain labels for the columns of the matrix, otherwise CLABS may be dimensioned of length 1.

Labels are right-justified when output. Any label that is too long for the column width, which is determined by FORMAT, is truncated.

13: NCOLS – INTEGER *Input*

On entry: the maximum output record length. If the number of columns of the matrix is too large to be accommodated in NCOLS characters, the matrix will be printed in parts, containing the largest possible number of matrix columns, and each part separated by a blank line.

NCOLS must be large enough to hold at least one column of the matrix using the format specifier in FORMAT. If a value less than 0 or greater than 132 is supplied for NCOLS, then the value 80 is used instead.

14: INDENT – INTEGER *Input*

On entry: the number of columns by which the matrix (and any title and labels) should be indented. The effective value of NCOLS is reduced by INDENT columns. If a value less than 0 or greater than NCOLS is supplied for INDENT, the value 0 is used instead.

15: 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, KL < 0.

IFAIL = 2

On entry, KU < 0.

IFAIL = 3

On entry, LDA $<$ KL + KU + 1.

IFAIL = 4

On entry, variable FORMAT is more than 80 characters long.

IFAIL = 5

The code supplied in FORMAT cannot be used to output a number. FORMAT probably has too wide a field width or contains an illegal edit descriptor.

IFAIL = 6

On entry, either LABROW or LABCOL $\neq$ 'N', 'I' or 'C'.

IFAIL = 7

The quantity NCOLS – INDENT – LABWID (where LABWID is the width needed for the row labels) is not large enough to hold at least one column of the matrix.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

This example program calls X04CFF twice, to print 5 by 5 matrices of different bandwidths; various options for labelling and formatting are illustrated.

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.

```
*     X04CFF 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, INDENT, J, NCOLS
*     .. Local Arrays ..
      real             A(LDA,LDA)
      CHARACTER*7      CLABS(NMAX), RLABS(NMAX)
*     .. External Subroutines ..
      EXTERNAL         X04CFF
*     .. Data statements ..
      DATA             CLABS/'Un', 'Deux', 'Trois', 'Quatre', 'Cinq'/
      DATA             RLABS/'Uno', 'Duo', 'Tre', 'Quattro', 'Cinque'/
*     .. Executable Statements ..
      WRITE (NOUT,*) 'X04CFF 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
*
      NCOLS = 80
      INDENT = 0
      IFAIL = 0
*
*     Print 5 by 5 band matrix with 1 sub-diagonal, 1 super-diagonal,
*     default format and integer row and column labels
      CALL X04CFF(5,5,1,1,A,LDA,' ','Example 1:','Integer',RLABS,
     +            'Integer',CLABS,NCOLS,INDENT,IFAIL)
*
      WRITE (NOUT,*)
*
*     Print 5 by 5 band matrix with 1 sub-diagonal, 2 super-diagonals,
*     user-supplied format and row and column labels
      CALL X04CFF(5,5,1,2,A,LDA,'F8.2','Example 2:','Character',RLABS,
     +            'Character',CLABS,NCOLS,INDENT,IFAIL)
*
      STOP
      END
```

9.2 Program Data

None.

9.3 Program Results

```
 X04CFF Example Program Results

 Example 1:
             1          2          3          4          5
 1     21.0000    12.0000
 2     31.0000    22.0000    13.0000
 3                32.0000    23.0000    14.0000
 4                           33.0000    24.0000    15.0000
 5                                      34.0000    25.0000

 Example 2:
              Un    Deux   Trois  Quatre    Cinq
     Uno   31.00   22.00   13.00
     Duo   41.00   32.00   23.00   14.00
     Tre           42.00   33.00   24.00   15.00
 Quattro                   43.00   34.00   25.00
  Cinque                           44.00   35.00
```