

NAG Library Routine Document

F01CKF

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

F01CKF returns with the result of the multiplication of two matrices B and C in the matrix A , with the option to overwrite B or C .

2 Specification

```
SUBROUTINE F01CKF(A, B, C, N, P, M, Z, IZ, OPT, IFAIL)
INTEGER          N, P, M, IZ, OPT, IFAIL
double precision A(N,P), B(N,M), C(M,P), Z(IZ)
```

3 Description

The n by m matrix B is post-multiplied by the m by p matrix C . If $\text{OPT} = 1$ the result is formed in the n by p matrix A . If $\text{OPT} = 2$, m must equal p , and the result is written back to B . If $\text{OPT} = 3$, n must equal m , and the result is written back to C .

4 References

None.

5 Parameters

- | | | |
|----|---|---------------------|
| 1: | $A(N,P)$ – <i>double precision</i> array
<i>On exit:</i> if $\text{OPT} = 1$, A contains the result of the matrix multiplication. | <i>Output</i> |
| 2: | $B(N,M)$ – <i>double precision</i> array
<i>On entry:</i> the n by m matrix B .
<i>On exit:</i> if $\text{OPT} = 2$, B contains the result of the multiplication. | <i>Input/Output</i> |
| 3: | $C(M,P)$ – <i>double precision</i> array
<i>On entry:</i> the m by p matrix C .
<i>On exit:</i> if $\text{OPT} = 3$, C contains the result of the multiplication. | <i>Input/Output</i> |
| 4: | N – INTEGER
<i>On entry:</i> n , the number of rows of the array A and of the array B .
<i>Constraints:</i>
if $\text{OPT} = 3$, $N = M$;
otherwise $N \geq 1$. | <i>Input</i> |
| 5: | P – INTEGER
<i>On entry:</i> p , the number of columns of the array A and of the array C . | <i>Input</i> |

Constraints:

if $\text{OPT} = 2$, $P = M$;
 otherwise $P \geq 1$.

6: M – INTEGER

Input

On entry: m , the number of columns of the array B and rows of the array C .

Constraints:

if $\text{OPT} = 2$, $M = P$;
 if $\text{OPT} = 3$, $M = N$;
 if $\text{OPT} \neq 1$, $M \leq \text{IZ}$;
 otherwise $M \geq 1$.

7: $Z(\text{IZ})$ – **double precision** array

Workspace

8: IZ – INTEGER

Input

On entry: the dimension of the array Z as declared in the (sub)program from which F01CKF is called.

Constraints:

if $\text{OPT} = 1$, $\text{IZ} \geq 1$;
 if $\text{OPT} \neq 1$, $\text{IZ} \geq M$.

9: OPT – INTEGER

Input

On entry: the value of OPT determines which array is to contain the final result.

$\text{OPT} = 1$

A must be distinct from B and C and, on exit, contains the result. B and C need not be distinct in this case.

$\text{OPT} = 2$

B must be distinct from C and on exit, contains the result. A is not used in this case and need not be distinct from B or C .

$\text{OPT} = 3$

C must be distinct from B and on exit, contains the result. A is not used in this case and need not be distinct from B or C .

Constraint: $1 \leq \text{OPT} \leq 3$.

10: 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: $\text{IFAIL} = 0$ 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, M or P or $N \leq 0$.

$IFAIL = 2$

$OPT = 2$ and $M \neq P$.

$IFAIL = 3$

$OPT = 3$ and $N \neq M$.

$IFAIL = 4$

$OPT \neq 1$ and $IZ < M$.

7 Accuracy

Each element of the result is effectively computed as an inner product using *basic precision*.

8 Further Comments

The time taken by F01CKF is approximately proportional to mnp .

9 Example

This example multiplies the 2 by 3 matrix B and the 3 by 2 matrix C together and places the result in the 2 by 2 matrix A .

9.1 Program Text

```
*      F01CKF Example Program Text
*      Mark 14 Revised. NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          N, M, P, IZ
      PARAMETER        (N=2,M=3,P=2,IZ=1)
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*      .. Local Scalars ..
      INTEGER          I, IFAIL, J, OPT
*      .. Local Arrays ..
      DOUBLE PRECISION A(N,P), B(N,M), C(M,P), Z(IZ)
*      .. External Subroutines ..
      EXTERNAL         F01CKF
*      .. Intrinsic Functions ..
      INTRINSIC        DBLE
*      .. Executable Statements ..
      WRITE (NOUT,*) 'F01CKF Example Program Results'
      DO 20 I = 1, M
         B(1,I) = DBLE(I) - 1.0D0
         C(I,1) = B(1,I)
         B(2,I) = DBLE(I)
         C(I,2) = B(2,I)
20  CONTINUE
      OPT = 1
      IFAIL = 1
*
      CALL F01CKF(A,B,C,N,P,M,Z,IZ,OPT,IFAIL)
```

```
*
      IF (IFAIL.EQ.0) THEN
        WRITE (NOUT,*)
        WRITE (NOUT,*) 'Matrix A'
        WRITE (NOUT,*)
        WRITE (NOUT,99999) ((A(I,J),J=1,P),I=1,N)
      ELSE
        WRITE (NOUT,99998) IFAIL
      END IF
*
99999 FORMAT (1X,2F7.1)
99998 FORMAT (1X,/1X,' ** F01CKF returned with IFAIL = ',I5)
      END
```

9.2 Program Data

None.

9.3 Program Results

F01CKF Example Program Results

Matrix A

5.0	8.0
8.0	14.0
