

NAG Library Routine Document

E04NLF/E04NLA

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

To supply optional parameters to E04NKF/E04NKA from an external file. More precisely, E04NLF must be used to supply optional parameters to E04NKF and E04NLA must be used to supply optional parameters to E04NKA.

E04NLA is a version of E04NLF that has additional parameters in order to make it safe for use in multithreaded applications (see Section 5). The initialization routine E04WBF **must** have been called before calling E04NLA.

2 Specification

2.1 Specification for E04NLF

```
SUBROUTINE E04NLF(IOPTNS, INFORM)
  INTEGER          IOPTNS, INFORM
```

2.2 Specification for E04NLA

```
SUBROUTINE E04NLA(IOPTNS, LWSAV, IWSAV, RWSAV, INFORM)
  INTEGER          IOPTNS, IWSAV(380), INFORM
  double precision RWSAV(285)
  LOGICAL          LWSAV(20)
```

3 Description

E04NLF/E04NLA may be used to supply values for optional parameters to E04NKF/E04NKA. E04NLF/E04NLA reads an external file and each line of the file defines a single optional parameter. It is only necessary to supply values for those parameters whose values are to be different from their default values.

Each optional parameter is defined by a single character string, of up to 72 characters, consisting of one or more items. The items associated with a given option must be separated by spaces, or equals signs [=]. Alphabetic characters may be upper or lower case. The string

```
Print Level = 1
```

is an example of a string used to set an optional parameter. For each option the string contains one or more of the following items:

- a mandatory keyword;
- a phrase that qualifies the keyword;
- a number that specifies an INTEGER or *double precision* value. Such numbers may be up to 16 contiguous characters in Fortran's I, F, E or D formats, terminated by a space if this is not the last item on the line.

Blank strings and comments are ignored. A comment begins with an asterisk (*) and all subsequent characters in the string are regarded as part of the comment.

The file containing the options must start with Begin and must finish with End. An example of a valid options file is:

```
Begin * Example options file
  Print level = 5
End
```

For E04NLF each line of the file is normally printed as it is read, on the current advisory message unit (see X04ABF), but printing may be suppressed using the keyword Nolist. To suppress printing of Begin, Nolist must be the first option supplied as in the file:

```
Begin
  Nolist
  Print level = 5
End
```

Printing will automatically be turned on again after a call to E04NKF or E04NLF and may be turned on again at any time using the keyword List.

For E04NLA printing is turned off by default, but may be turned on at any time using the keyword List.

Optional parameter settings are preserved following a call to E04NKF/E04NKA and so the keyword Defaults is provided to allow you to reset all the optional parameters to their default values before a subsequent call to E04NKF/E04NKA.

A complete list of optional parameters, their abbreviations, synonyms and default values is given in Section 11 in E04NKF/E04NKA.

4 References

None.

5 Parameters

1: IOPTNS – INTEGER *Input*

On entry: the unit number of the options file to be read.

Constraint: $0 \leq \text{IOPTNS} \leq 99$.

2: INFORM – INTEGER *Output*

Note: for E04NLA, INFORM does not occur in this position in the parameter list. See the additional parameters described below.

On exit: contains zero if the options file has been successfully read and a value > 0 otherwise (see Section 6).

Note: the following are additional parameters for specific use with E04NLA. Users of E04NLF therefore need not read the remainder of this description.

2: LWSAV(20) – LOGICAL array *Communication Array*

3: IWSAV(380) – INTEGER array *Communication Array*

4: RWSAV(285) – **double precision** array *Communication Array*

The arrays LWSAV, IWSAV and RWSAV **must not** be altered between calls to any of the routines E04NLA, E04NKA, E04NMA or E04WBF.

5: INFORM – INTEGER *Output*

Note: see the parameter description for INFORM above.

6 Error Indicators and Warnings

Errors or warnings detected by the routine:

INFORM = 1

IOPTNS is not in the range $[0, 99]$.

INFORM = 2

Begin was found, but end-of-file was found before End was found.

INFORM = 3

end-of-file was found before Begin was found.

INFORM = 4

Not used.

INFORM = 5

One or more lines of the options file is invalid. Check that all keywords are neither ambiguous nor misspelt.

7 Accuracy

Not applicable.

8 Further Comments

E04NMF/E04NMA may also be used to supply optional parameters to E04NKF/E04NKA.

9 Example

This example solves the same problem as the example for E04NKF/E04NKA, but in addition illustrates the use of E04NLF/E04NLA and E04NMF/E04NMA to set optional parameters for E04NKF/E04NKA.

In this example the options file read by E04NLF/E04NLA is appended to the data file for the program (see Section 9.2). It would usually be more convenient in practice to keep the data file and the options file separate.

9.1 Program Text

Note: the following program illustrates the use of E04NLF. An equivalent program illustrating the use of E04NLA is available with the supplied Library and is also available from the NAG web site.

```
*      E04NLF Example Program Text
*      Mark 19 Revised. NAG Copyright 1999.
*      .. Parameters ..
      INTEGER          NIN, NOUT
      PARAMETER        (NIN=5,NOUT=6)
      INTEGER          IDUMMY
      PARAMETER        (IDUMMY=-11111)
      INTEGER          NMAX, MMAX, NNZMAX, LENIZ, LENZ
      PARAMETER        (NMAX=100,MMAX=100,NNZMAX=100,LENIZ=10000,
+                      LENZ=10000)
*      .. Local Scalars ..
      DOUBLE PRECISION OBJ, SINF
      INTEGER          I, ICOL, IFAIL, INFORM, IOBJ, J, JCOL, M, MINIZ,
+                      MINZ, N, NCOLH, NINF, NNAME, NNZ, NS, OUTCHN
      LOGICAL          LMOK
      CHARACTER        START
*      .. Local Arrays ..
      DOUBLE PRECISION A(NNZMAX), BL(NMAX+MMAX), BU(NMAX+MMAX),
+                      CLAMDA(NMAX+MMAX), XS(NMAX+MMAX), Z(LENZ)
      INTEGER          HA(NNZMAX), ISTATE(NMAX+MMAX), IZ(LENIZ),
+                      KA(NMAX+1)
      CHARACTER*8      CRNAME(NMAX+MMAX), NAMES(5)
*      .. External Functions ..
      LOGICAL          A00ACF
      EXTERNAL          A00ACF
*      .. External Subroutines ..
      EXTERNAL          E04NKF, E04NLF, E04NMF, QPHX, X04ABF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'E04NLF Example Program Results'
      OUTCHN = NOUT
*      Skip heading in data file.
```

```

      READ (NIN,*)
      READ (NIN,*) N, M
      LMOK = A00ACF()
      IF ( .NOT. LMOK) THEN
        WRITE (NOUT,*)
        WRITE (NOUT,*) ' ** A valid licence key was not found'
      ELSE IF (N.GT.NMAX .OR. M.GT.MMAX) THEN
        WRITE (NOUT,*)
        WRITE (NOUT,*) ' ** At least one of N or M is too large'
      ELSE
*
*       Read NNZ, IOBJ, NCOLH, START and NNAME from data file.
*
        READ (NIN,*) NNZ, IOBJ, NCOLH, START, NNAME
*
*       Read NAMES and CRNAME from data file.
*
        READ (NIN,*) (NAMES(I),I=1,5)
        READ (NIN,*) (CRNAME(I),I=1,NNAME)
*
*       Read the matrix A from data file. Set up KA.
*
        JCOL = 1
        KA(JCOL) = 1
        DO 40 I = 1, NNZ
*
*         Element ( HA( I ), ICOL ) is stored in A( I ).
*
          READ (NIN,*) A(I), HA(I), ICOL
*
          IF (ICOL.LT.JCOL) THEN
*
*           Elements not ordered by increasing column index.
*
            WRITE (NOUT,99999) 'Element in column', ICOL,
+              ' found after element in column', JCOL, '. Problem',
+              ' abandoned.'
            GO TO 80
          ELSE IF (ICOL.EQ.JCOL+1) THEN
*
*           Index in A of the start of the ICOL-th column equals I.
*
            KA(ICOL) = I
            JCOL = ICOL
          ELSE IF (ICOL.GT.JCOL+1) THEN
*
*           Index in A of the start of the ICOL-th column equals I,
*           but columns JCOL+1,JCOL+2,...,ICOL-1 are empty. Set the
*           corresponding elements of KA to I.
*
            DO 20 J = JCOL + 1, ICOL - 1
              KA(J) = I
            CONTINUE
            KA(ICOL) = I
            JCOL = ICOL
          END IF
        40 CONTINUE
*
        KA(N+1) = NNZ + 1
*
        IF (N.GT.ICOL) THEN
*
*         Columns N,N-1,...,ICOL+1 are empty. Set the corresponding
*         elements of KA accordingly.
*
          DO 60 I = N, ICOL + 1, -1
            IF (KA(I).EQ.IDUMMY) KA(I) = KA(I+1)
          60 CONTINUE
        END IF
*
*       Read BL, BU, ISTATE and XS from data file.

```

```

*
      READ (NIN,*) (BL(I),I=1,N+M)
      READ (NIN,*) (BU(I),I=1,N+M)
      IF (START.EQ.'C') THEN
        READ (NIN,*) (ISTATE(I),I=1,N)
      ELSE IF (START.EQ.'W') THEN
        READ (NIN,*) (ISTATE(I),I=1,N+M)
      END IF
      READ (NIN,*) (XS(I),I=1,N)
*
*      Set three options using E04NMF.
*
      CALL E04NMF(' Check Frequency = 10 ')
*
      CALL E04NMF(' Crash Tolerance = 0.05 ')
*
      CALL E04NMF(' Infinite Bound Size = 1.0E+25 ')
*
      Set the unit number for advisory messages to OUTCHN.
*
      CALL X04ABF(1,OUTCHN)
*
      Read the options file for the remaining options.
*
      CALL E04NLF(NIN,INFORM)
*
      IF (INFORM.NE.0) THEN
        WRITE (NOUT,99998) 'E04NLF terminated with INFORM = ',
+          INFORM
        GO TO 80
      END IF
*
      Solve the QP problem.
*
      IFAIL = 1
*
      CALL E04NKF(N,M,NNZ,IOBJ,NCOLH,QPHX,A,HA,KA,BL,BU,START,NAMES,
+          NNAME,CRNAME,NS,XS,ISTATE,MINIZ,MINZ,NINF,SINF,OBJ,
+          CLAMDA,IZ,LENIZ,Z,LENZ,IFAIL)
*
      IF (IFAIL.NE.0) THEN
        WRITE (NOUT,99998) ' ** E04NLF returned with IFAIL = ',
+          IFAIL
      END IF
*
      END IF
80 CONTINUE
*
99999 FORMAT (/1X,A,I5,A,I5,A,A)
99998 FORMAT (1X,A,I5)
END
*
SUBROUTINE QPHX(NSTATE,NCOLH,X,HX)
*
*      Routine to compute H*x. (In this version of QPHX, the Hessian
*      matrix H is not referenced explicitly.)
*
*      .. Parameters ..
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
      DOUBLE PRECISION TWO
      PARAMETER        (TWO=2.0D+0)
*
*      .. Scalar Arguments ..
      INTEGER          NCOLH, NSTATE
*
*      .. Array Arguments ..
      DOUBLE PRECISION HX(NCOLH), X(NCOLH)
*
*      .. Executable Statements ..
      IF (NSTATE.EQ.1) THEN
*
*          First entry.
*

```

```

      WRITE (NOUT,99999) NCOLH
*
      END IF
*
*      Normal entry.
*
      HX(1) = TWO*X(1)
      HX(2) = TWO*X(2)
      HX(3) = TWO*(X(3)+X(4))
      HX(4) = HX(3)
      HX(5) = TWO*X(5)
      HX(6) = TWO*(X(6)+X(7))
      HX(7) = HX(6)
*
      IF (NSTATE.GE.2) THEN
*
*      Final entry.
*
      WRITE (NOUT,99998)
*
      END IF
*
      RETURN
*
99999 FORMAT (/ ' This is the E04NKF example.   NCOLH =',I4,',' )
99998 FORMAT (/ ' Finished the E04NKF example.' )
      END

```

9.2 Program Data

E04NLF Example Program Data

```

  7  8      :Values of N and M
48  8  7  'C' 15 :Values of NNZ, IOBJ, NCOLH, START and NNAME
,      ,      ,      ,      ,      ,      ,      :End of NAMES
'...X1...' '...X2...' '...X3...' '...X4...' '...X5...'
'...X6...' '...X7...' '..ROW1..' '..ROW2..' '..ROW3..'
'..ROW4..' '..ROW5..' '..ROW6..' '..ROW7..' '..COST..' :End of CRNAME
  0.02    7    1
  0.02    5    1
  0.03    3    1
  1.00    1    1
  0.70    6    1
  0.02    4    1
  0.15    2    1
-200.00   8    1
  0.06    7    2
  0.75    6    2
  0.03    5    2
  0.04    4    2
  0.05    3    2
  0.04    2    2
  1.00    1    2
-2000.00  8    2
  0.02    2    3
  1.00    1    3
  0.01    4    3
  0.08    3    3
  0.08    7    3
  0.80    6    3
-2000.00  8    3
  1.00    1    4
  0.12    7    4
  0.02    3    4
  0.02    4    4
  0.75    6    4
  0.04    2    4
-2000.00  8    4
  0.01    5    5
  0.80    6    5
  0.02    7    5

```

```

1.00 1 5
0.02 2 5
0.06 3 5
0.02 4 5
-2000.00 8 5
1.00 1 6
0.01 2 6
0.01 3 6
0.97 6 6
0.01 7 6
400.00 8 6
0.97 7 7
0.03 2 7
1.00 1 7
400.00 8 7
                                :End of matrix A
0.0 0.0 4.0E+02 1.0E+02 0.0 0.0 0.0 2.0E+03
-1.0E+26 -1.0E+26 -1.0E+26 -1.0E+26 1.5E+03 2.5E+02 -1.0E+26 :End of BL
2.0E+02 2.5E+03 8.0E+02 7.0E+02 1.5E+03 1.0E+26 1.0E+26 2.0E+03
6.0E+01 1.0E+02 4.0E+01 3.0E+01 1.0E+26 3.0E+02 1.0E+26 :End of BU
0 0 0 0 0 0 0 0 :End of ISTATE
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 :End of XS
Begin * Example options file for E04NLF
  Iteration Limit = 25 * (Default = 75)
  Print Level = 1 * (Default = 10)
End

```

9.3 Program Results

E04NLF Example Program Results

Calls to E04NMF

```

Check Frequency = 10
Crash Tolerance = 0.05
Infinite Bound Size = 1.0E+25

```

OPTIONS file

```

Begin * Example options file for E04NLF
  Iteration Limit = 25 * (Default = 75)
  Print Level = 1 * (Default = 10)
End

```

*** E04NKF

Parameters

```

Frequencies.
Check frequency..... 10          Expand frequency..... 10000
Factorization frequency. 100

LP Parameters.
Scale tolerance..... 9.00E-01      Feasibility tolerance... 1.00E-06
Iteration limit..... 25          Scale option..... 2
Optimality tolerance.... 1.00E-06   Partial price..... 10
Crash tolerance..... 5.00E-02      Pivot tolerance..... 2.04E-11
Crash option..... 2

QP objective.
Objective variables..... 7          Hessian columns..... 7
Superbasics limit..... 7

Miscellaneous.
Variables..... 7          Linear constraints..... 8
LU factor tolerance..... 1.00E+02   LU update tolerance..... 1.00E+01

```

```

LU singularity tolerance  2.04E-11      Monitoring file.....      -1
EPS (machine precision).  1.11E-16      Print level.....          1
Infinite bound size.....  1.00E+25      Infinite step size.....  1.00E+25
COLD start.....          MINIMIZE.....

```

```

Workspace provided is      IZ(  10000), Z(  10000).
To start solving the problem we need IZ(    428), Z(    358).

```

This is the E04NKF example. NCOLH = 7.

Variable	State	Value	Lower Bound	Upper Bound	Lagr Mult	Residual
...X1...	LL	0.00000	.	200.00	2361.	.
...X2...	BS	349.399	.	2500.0	-1.2975E-12	349.4
...X3...	SBS	648.853	400.00	800.00	-5.7329E-13	151.1
...X4...	SBS	172.847	100.00	700.00	6.4970E-13	72.85
...X5...	BS	407.521	.	1500.0	9.1881E-13	407.5
...X6...	BS	271.356	.	None	-1.1928E-12	271.4
...X7...	BS	150.023	.	None	-1.4130E-12	150.0

Constrnt	State	Value	Lower Bound	Upper Bound	Lagr Mult	Residual
..ROW1..	EQ	2000.00	2000.0	2000.0	-1.2901E+04	.
..ROW2..	BS	49.2316	None	60.000	.	-10.77
..ROW3..	UL	100.000	None	100.00	-2325.	.
..ROW4..	BS	32.0719	None	40.000	.	-7.928
..ROW5..	BS	14.5572	None	30.000	.	-15.44
..ROW6..	LL	1500.00	1500.0	None	1.4455E+04	.
..ROW7..	LL	250.000	250.00	300.00	1.4581E+04	.
..COST..	BS	-2.988690E+06	None	None	-1.000	-2.9887E+06

Finished the E04NKF example.

Exit E04NKF - Optimal QP solution found.

Final QP objective value = -1847785.

Exit from QP problem after 10 iterations.