

NAG Library Routine Document

G05NCF

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

G05NCF performs a pseudorandom permutation of a vector of integers.

2 Specification

```
SUBROUTINE G05NCF (INDEX, N, STATE, IFAIL)
INTEGER          INDEX(N), N, STATE(lstate), IFAIL
```

3 Description

G05NCF permutes the elements of an integer array without inspecting their values. Each of the $n!$ possible permutations of the n values may be regarded as being equally probable.

Even for modest values of n it is theoretically impossible that all $n!$ permutations may occur, as $n!$ is likely to exceed the cycle length of any of the base generators. For practical purposes this is irrelevant, as the time necessary to generate all possible permutations is many millenia.

One of the initialization routines G05KFF (for a repeatable sequence if computed sequentially) or G05KGF (for a non-repeatable sequence) must be called prior to the first call to G05NCF.

4 References

Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin
 Knuth D E (1981) *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley

5 Parameters

- 1: INDEX(N) – INTEGER array *Input/Output*
On entry: the n integer values to be permuted.
On exit: the n permuted integer values.
- 2: N – INTEGER *Input*
On entry: the number of values to be permuted.
Constraint: $N \geq 1$.
- 3: STATE(lstate) – INTEGER array *Communication Array*
Note: *lstate* = LSTATE, the dimension of STATE as supplied to the initialization routine G05KFF or G05KGF.
On entry: contains information on the selected base generator and its current state.
On exit: contains updated information on the state of the generator.
- 4: 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 = 2

On entry, $N < 1$.

IFAIL = 3

On entry, STATE vector was not initialized or has been corrupted.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

In the example program a vector containing the first eight positive integers in ascending order is permuted by a call to G05NCF and the permutation is printed. This is repeated a total of ten times, after initialization by G05KFF.

9.1 Program Text

```
*      G05NCF Example Program Text
*      Mark 22 Release. NAG Copyright 2006.
*      .. Parameters ..
      INTEGER                NOUT
      PARAMETER              (NOUT=6)
      INTEGER                MSTATE, MSEED, N
      PARAMETER              (MSTATE=633, MSEED=1, N=8)
*      .. Local Scalars ..
      INTEGER                GENID, I, IFAIL, J, LSEED, LSTATE, M, SUBID
*      .. Local Arrays ..
      INTEGER                INDEX(N), SEED(MSEED), STATE(MSTATE)
*      .. External Subroutines ..
      EXTERNAL              G05KFF, G05NCF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G05NCF Example Program Results'
      WRITE (NOUT,*)
*      Number of permutations
      M = 10
*      Initialize the seed
      SEED(1) = 1762543
*      GENID and SUBID identify the base generator
      GENID = 1
      SUBID = 1
*      Initialize the generator to a repeatable sequence
      LSTATE = MSTATE
```

```

      LSEED = MSEED
      IFAIL = 1
      CALL G05KFF(GENID,SUBID,SEED,LSEED,STATE,LSTATE,IFAIL)
      IF (IFAIL.NE.0) THEN
        WRITE (NOUT,99997) IFAIL
        GO TO 60
      END IF
*
      WRITE (NOUT,99998) M, ' Permutations of first ', N, ' integers'
      WRITE (NOUT,*)
*      Permutate M times
      DO 40 J = 1, M
*        Set up the index vector
        DO 20 I = 1, N
          INDEX(I) = I
        20 CONTINUE
*        Call the permutation routine
        IFAIL = 1
        CALL G05NCF(INDEX,N,STATE,IFAIL)
        IF (IFAIL.NE.0) THEN
          WRITE (NOUT,99996) IFAIL
          GO TO 60
        END IF
*        Display the results
        WRITE (NOUT,99999) (INDEX(I),I=1,N)
      40 CONTINUE
*
      60 CONTINUE
*
99999 FORMAT (1X,8I3)
99998 FORMAT (1X,I2,A,I1,A)
99997 FORMAT (1X,' ** G05KFF returned with IFAIL = ',I5)
99996 FORMAT (1X,' ** G05NCF returned with IFAIL = ',I5)
      END

```

9.2 Program Data

None.

9.3 Program Results

G05NCF Example Program Results

10 Permutations of first 8 integers

6	2	4	8	1	3	5	7
8	6	4	2	7	3	1	5
4	2	8	7	5	6	3	1
1	6	4	5	2	3	7	8
1	7	3	8	4	2	5	6
6	3	4	7	1	2	8	5
6	4	1	8	2	5	3	7
3	2	1	7	5	8	6	4
4	2	1	5	3	6	8	7
1	5	6	4	2	7	8	3
