

NAG Library Routine Document

G05LHF

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

G05LHF generates a vector of pseudorandom numbers from a triangular distribution with parameters $x_{\min}$, $x_{\max}$ and x_{med} .

2 Specification

```
SUBROUTINE G05LHF(XMIN, XMAX, XMED, N, X, IGEN, ISEED, IFAIL)
  INTEGER          N, IGEN, ISEED(4), IFAIL
  double precision XMIN, XMAX, XMED, X(N)
```

3 Description

The triangular distribution has a PDF (probability density function) that is triangular in profile. The base of the triangle ranges from $x = x_{\min}$ to $x = x_{\max}$ and the PDF has a maximum value of $\frac{2}{x_{\max} - x_{\min}}$ at $x = x_{\text{med}}$. If $x_{\min} = x_{\text{med}} = x_{\max}$ then $x = x_{\text{med}}$ with probability 1; otherwise the triangular distribution has PDF:

$$f(x) = \frac{x - x_{\min}}{x_{\text{med}} - x_{\min}} \times \frac{2}{x_{\max} - x_{\min}} \quad \text{if } x_{\min} < x \leq x_{\text{med}},$$

$$f(x) = \frac{x_{\max} - x}{x_{\max} - x_{\text{med}}} \times \frac{2}{x_{\max} - x_{\min}} \quad \text{if } x_{\text{med}} < x \leq x_{\max},$$

$$f(x) = 0 \quad \text{otherwise.}$$

One of the initialization routines G05KBF (for a repeatable sequence if computed sequentially) or G05KCF (for a non-repeatable sequence) must be called prior to the first call to G05LHF.

4 References

Knuth D E (1981) *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley

5 Parameters

1: XMIN – **double precision** *Input*
 2: XMAX – **double precision** *Input*

On entry: the end points $x_{\min}$ and $x_{\max}$ of the uniform distribution.

Constraint: $XMIN \leq XMAX$.

3: XMED – **double precision** *Input*

On entry: the median of the distribution x_{med} (also the location of the vertex of the triangular distribution at which the PDF reaches a maximum).

Constraint: $XMIN \leq XMED \leq XMAX$.

- 4: N – INTEGER *Input*
On entry: n , the number of pseudorandom numbers to be generated.
Constraint: $N \geq 0$.
- 5: X(N) – **double precision** array *Output*
On exit: the n pseudorandom numbers from the specified triangular distribution.
- 6: IGEN – INTEGER *Input*
On entry: must contain the identification number for the generator to be used to return a pseudorandom number and should remain unchanged following initialization by a prior call to G05KBF or G05KCF.
- 7: ISEED(4) – INTEGER array *Communication Array*
On entry: contains values which define the current state of the selected generator.
On exit: contains updated values defining the new state of the selected generator.
- 8: 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 = 1

On entry, $XMAX < XMIN$.

IFAIL = 2

On entry, $XMED < XMIN$,
 or $XMED > XMAX$.

IFAIL = 3

On entry, $N < 0$.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

This example prints five pseudorandom numbers from a triangular distribution with parameters $x_{\min} = -1.0$, $x_{\max} = 1.0$ and $x_{\text{med}} = 0.5$, generated by a single call to G05LHF, after initialization by G05KBF.

9.1 Program Text

```
*      G05LHF Example Program Text
*      Mark 20 Release. NAG Copyright 2001.
*      .. Parameters ..
      INTEGER          NOUT, N
      PARAMETER        (NOUT=6,N=5)
*      .. Local Scalars ..
      DOUBLE PRECISION XMAX, XMED, XMIN
      INTEGER          IFAIL, IGEN
*      .. Local Arrays ..
      DOUBLE PRECISION X(N)
      INTEGER          ISEED(4)
*      .. External Subroutines ..
      EXTERNAL         G05KBF, G05LHF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G05LHF Example Program Results'
      WRITE (NOUT,*)
*      Initialize the seed to a repeatable sequence
      ISEED(1) = 1762543
      ISEED(2) = 9324783
      ISEED(3) = 42344
      ISEED(4) = 742355
*      IGEN identifies the stream.
      IGEN = 1
      CALL G05KBF(IGEN,ISEED)
*
      XMIN = -1.0D0
      XMAX = 1.0D0
      XMED = 0.5D0
      IFAIL = 1
      CALL G05LHF(XMIN,XMAX,XMED,N,X,IGEN,ISEED,IFAIL)
*
      IF (IFAIL.EQ.0) THEN
*
          WRITE (NOUT,99999) X
*
      ELSE
          WRITE (NOUT,99998) IFAIL
      END IF
*
99999 FORMAT (1X,F10.4)
99998 FORMAT (1X,' ** G05LHF returned with IFAIL = ',I5)
      END
```

9.2 Program Data

None.

9.3 Program Results

G05LHF Example Program Results

```
-0.4823
 0.7786
 0.1042
 0.4932
 0.7759
```