

NAG Library Routine Document

G05LAF

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

G05LAF generates a vector of pseudorandom numbers taken from a Normal (Gaussian) distribution with mean μ and variance σ^2 .

2 Specification

```
SUBROUTINE G05LAF(XMU, VAR, N, X, IGEN, ISEED, IFAIL)
  INTEGER          N, IGEN, ISEED(4), IFAIL
  double precision XMU, VAR, X(N)
```

3 Description

The distribution has PDF (probability distribution function)

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right).$$

G05LAF uses the Box–Muller method.

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 G05LAF.

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: | XMU – double precision
<i>On entry:</i> μ , the mean of the distribution. | <i>Input</i> |
| 2: | VAR – double precision
<i>On entry:</i> σ^2 , the variance of the distribution.
<i>Constraint:</i> VAR $\geq$ 0.0. | <i>Input</i> |
| 3: | N – INTEGER
<i>On entry:</i> n , the number of pseudorandom numbers to be generated.
<i>Constraint:</i> N $\geq$ 0. | <i>Input</i> |
| 4: | X(N) – double precision array
<i>On exit:</i> the n pseudorandom numbers from the specified Normal distribution. | <i>Output</i> |

- 5: 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.
- 6: 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.
- 7: 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, $N < 0$.

IFAIL = 2

On entry, $VAR < 0.0$.

7 Accuracy

The generated numbers conform to a Normal distribution with an accuracy of $\sqrt{\text{machine precision}}$.

8 Further Comments

None.

9 Example

This example prints five pseudorandom numbers from a Normal distribution with mean 1.0 and variance 1.5, generated by a single call to G05LAF, after initialization by G05KBF.

9.1 Program Text

```
*      G05LAF Example Program Text
*      Mark 20 Release. NAG Copyright 2001.
*      .. Parameters ..
      INTEGER          NOUT, N
      PARAMETER        (NOUT=6,N=5)
*      .. Local Scalars ..
      DOUBLE PRECISION VAR, XMU
      INTEGER          I, IFAIL, IGEN
*      .. Local Arrays ..
```

```

      DOUBLE PRECISION X(N)
      INTEGER          ISEED(4)
*    .. External Subroutines ..
      EXTERNAL          G05KBF, G05LAF
*    .. Executable Statements ..
      WRITE (NOUT,*) 'G05LAF 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)
*
      XMU = 1.0D0
      VAR = 1.5D0
      IFAIL = 1
      CALL G05LAF(XMU,VAR,N,X,IGEN,ISEED,IFAIL)
*
      IF (IFAIL.EQ.0) THEN
        WRITE (NOUT,99999) (X(I),I=1,N)
      ELSE
        WRITE (NOUT,99998) IFAIL
      END IF
*
99999 FORMAT (1X,F10.4)
99998 FORMAT (1X,' ** G05LAF returned with IFAIL = ',I5)
      END

```

9.2 Program Data

None.

9.3 Program Results

G05LAF Example Program Results

```

3.5652
0.1837
0.9297
-0.6421
0.6371

```
