NAG Library Routine Document

G05SHF

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

G05SHF generates a vector of pseudorandom numbers taken from an F (or Fisher's variance ratio) distribution with μ and ν degrees of freedom.

2 Specification

```
SUBROUTINE G05SHF(N, DF1, DF2, STATE, X, IFAIL)
INTEGER           N, DF1, DF2, STATE(lstate), IFAIL
double precision  X(N)
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{\left(\frac{\mu+\nu-2}{2}\right)!x^{\frac{1}{2}\mu-1}}{\left(\frac{1}{2}\mu-1\right)!\left(\frac{1}{2}\nu-1\right)!\left(1+\frac{\mu}{\nu}x\right)^{\frac{1}{2}(\mu+\nu)}} \times \left(\frac{\mu}{\nu}\right)^{\frac{1}{2}\mu} \quad \text{if } x > 0,$$

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

G05SHF calculates the values

$$\frac{\nu y_i}{\mu z_i}, \qquad i = 1, 2, \ldots, n,$$

where y_i and z_i are generated by G05SJF from gamma distributions with parameters $\left(\frac{1}{2}\mu, 2\right)$ and $\left(\frac{1}{2}\nu, 2\right)$ respectively (i.e., from χ^2-distributions with μ and ν degrees of freedom).

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 G05SHF.

4 References

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

5 Parameters

1: N – INTEGER *Input*

On entry: n, the number of pseudorandom numbers to be generated.

Constraint: N ≥ 0.

2: DF1 – INTEGER *Input*

On entry: μ, the number of degrees of freedom of the distribution.

Constraint: DF1 ≥ 1.

3: DF2 – INTEGER *Input*

On entry: ν, the number of degrees of freedom of the distribution.

Constraint: DF2 ≥ 1.

4: 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.

5: X(N) – ***double precision*** array *Output*

On exit: the n pseudorandom numbers from the specified F-distribution.

6: 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, DF1 < 1.

IFAIL $= 3$

On entry, DF2 < 1.

IFAIL $= 4$

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

7 Accuracy

Not applicable.

8 Further Comments

The time taken by G05SHF increases with μ and ν.

9 Example

This example prints five pseudorandom numbers from an F-distribution with two and three degrees of freedom, generated by a single call to G05SHF, after initialization by G05KFF.

9.1 Program Text

```
*     G05SHF 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=5)
*     .. Local Scalars ..
      INTEGER          DF1, DF2, GENID, I, IFAIL, LSEED, LSTATE, SUBID
*     .. Local Arrays ..
      DOUBLE PRECISION X(N)
      INTEGER          SEED(MSEED), STATE(MSTATE)
*     .. External Subroutines ..
      EXTERNAL         G05KFF, G05SHF
*     .. Executable Statements ..
      WRITE (NOUT,*) 'G05SHF Example Program Results'
      WRITE (NOUT,*)
*     Set the distribution parameters DF1 and DF2
      DF1 = 2
      DF2 = 3
*     Initialize the seed to a repeatable sequence
      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,99998) IFAIL
         GO TO 20
      END IF
*     Generate the variates
      IFAIL = 1
      CALL G05SHF(N,DF1,DF2,STATE,X,IFAIL)
      IF (IFAIL.NE.0) THEN
         WRITE (NOUT,99997) IFAIL
         GO TO 20
      END IF
*     Display the variates
      WRITE (NOUT,99999) (X(I),I=1,N)
*
   20 CONTINUE
*
99999 FORMAT (1X,F10.4)
99998 FORMAT (1X,' ** G05KFF returned with IFAIL = ',I5)
99997 FORMAT (1X,' ** G05SHF returned with IFAIL = ',I5)
      END
```

9.2 Program Data

None.

9.3 Program Results

```
 G05SHF Example Program Results

     1.4401
     1.8083
     0.3638
     0.5464
     4.0895
```