

NAG Library Routine Document

G05SDF

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

G05SDF generates a vector of pseudorandom numbers taken from a χ^2 -distribution with ν degrees of freedom.

2 Specification

```
SUBROUTINE G05SDF(N, DF, STATE, X, IFAIL)
  INTEGER          N, DF, STATE(lstate), IFAIL
  double precision X(N)
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{x^{\nu/2-1} \times e^{-x/2}}{2^{\nu/2} \times (\nu/2 - 1)!} \quad \text{if } x > 0;$$

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

This is the same as a gamma distribution with parameters $\nu/2$ and 2.

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 G05SDF.

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: N – INTEGER *Input*
On entry: n , the number of pseudorandom numbers to be generated.
Constraint: $N \geq 0$.
- 2: DF – INTEGER *Input*
On entry: ν , the number of degrees of freedom of the distribution.
Constraint: $DF \geq 1$.
- 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: $X(N)$ – *double precision* array *Output*

On exit: the N pseudorandom numbers from the specified χ^2 -distribution.

5: 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, $DF < 1$.

IFAIL = 3

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

7 Accuracy

Not applicable.

8 Further Comments

The time taken by G05SDF increases with ν .

9 Example

This example prints five pseudorandom numbers from a χ^2 -distribution with five degrees of freedom, generated by a single call to G05SDF, after initialization by G05KFF.

9.1 Program Text

```
*      G05SDF 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          DF, GENID, I, IFAIL, LSEED, LSTATE, SUBID
*      .. Local Arrays ..
      DOUBLE PRECISION X(N)
      INTEGER          SEED(MSEED), STATE(MSTATE)
*      .. External Subroutines ..
```

```

EXTERNAL          G05KFF, G05SDF
*
.. Executable Statements ..
WRITE (NOUT,*) 'G05SDF Example Program Results'
WRITE (NOUT,*)
*
Set the distribution parameter DF
DF = 5
*
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 G05SDF(N,DF,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,' ** G05SDF returned with IFAIL = ',I5)
END

```

9.2 Program Data

None.

9.3 Program Results

G05SDF Example Program Results

```

4.4731
5.9371
1.7636
2.9812
4.3280

```
