G05DJF – NAG Fortran Library Routine Document

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

G05DJF returns a pseudo-random real number taken from a Student's t-distribution with n degrees of freedom.

2 Specification

```
real FUNCTION G05DJF(N, IFAIL)
INTEGER              N, IFAIL
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{\left(\frac{n-1}{2}\right)!}{\left(\frac{1}{2}n-1\right)!\sqrt{\pi n}\left(1+\frac{x^2}{n}\right)^{\frac{1}{2}(n+1)}}.$$

The routine returns the value

$$y\sqrt{\frac{n}{z}}$$

where y is generated by G05DDF from a Normal distribution with mean 0 and standard deviation 1.0, and z is generated by G05DGF from a gamma distribution with parameters $\frac{1}{2}n$ and 2 (i.e., from a χ^2 distribution with n degrees of freedom).

4 References

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

5 Parameters

1: N — INTEGER *Input*

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

Constraint: N ≥ 1.

2: IFAIL — INTEGER *Input/Output*

On entry: IFAIL must be set to 0, −1 or 1. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.

On exit: IFAIL = 0 unless the routine detects an error (see Section 6).

6 Error Indicators and Warnings

Errors detected by the routine:

IFAIL = 1

On entry, N < 1.

7 Accuracy

Not applicable.

8 Further Comments

The time taken by the routine increases with n.

9 Example

The example program prints the first five pseudo-random real numbers from a Student's t-distribution with 5 degrees of freedom, generated by G05DJF after initialisation by G05CBF.

The generator mechanism used is selected by an initial call to G05ZAF.

9.1 Program Text

Note. The listing of the example program presented below uses bold italicised terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*     G05DJF Example Program Text
*     NAG Fortran SMP Library, Release 2.  NAG Copyright 2000.
*     .. Parameters ..
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*     .. Local Scalars ..
      DOUBLE PRECISION X
      INTEGER          I, IFAIL
*     .. External Functions ..
      DOUBLE PRECISION G05DJF
      EXTERNAL         G05DJF
*     .. External Subroutines ..
      EXTERNAL         G05CBF, G05ZAF
*     .. Executable Statements ..
      CALL G05ZAF('O')
      WRITE (NOUT,*) 'G05DJF Example Program Results'
      WRITE (NOUT,*)
      CALL G05CBF(0)
      IFAIL = 0
      DO 20 I = 1, 5
*
         X = G05DJF(5,IFAIL)
*
         WRITE (NOUT,99999) X
   20 CONTINUE
      STOP
*
99999 FORMAT (1X,F10.4)
      END
```

9.2 Program Data

None.

9.3 Program Results

```
G05DJF Example Program Results

    0.9435
    1.3828
   -0.4164
    1.0801
    1.1445
```