

NAG Fortran Library Routine Document

G05DJF

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 G05FFF 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

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

5 Parameters

1: N – INTEGER *Input*

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

Constraint: $N \geq 1$.

2: IFAIL – INTEGER *Input/Output*

On entry: IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 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, for users 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, $N < 1$.

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 five 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
*      Mark 20 Revised. NAG Copyright 2001.
*      .. Parameters ..
      INTEGER          NOUT
      PARAMETER       (NOUT=6)
*      .. Local Scalars ..
      real            X
      INTEGER          I, IFAIL
*      .. External Functions ..
      real            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
```
