# NAG Fortran Library Routine Document

# G05DHF

**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

G05DHF returns a pseudo-random real number taken from a $\chi^2$ distribution with $n$ degrees of freedom.

## 2 Specification

```
real FUNCTION G05DHF(N, IFAIL)
INTEGER              N, IFAIL
```

## 3 Description

The distribution has PDF (probability density function)

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

This is the same as a gamma distribution with parameters $\frac{1}{2}n$ and 2; the routine calls G05FFF with these parameters.

## 4 References

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

Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin

## 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 $\chi^2$ distribution with five degrees of freedom, generated by G05DHF 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.

```
*     G05DHF 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             G05DHF
      EXTERNAL         G05DHF
*     .. External Subroutines ..
      EXTERNAL         G05CBF, G05ZAF
*     .. Executable Statements ..
      CALL G05ZAF('O')
      WRITE (NOUT,*) 'G05DHF Example Program Results'
      WRITE (NOUT,*)
      CALL G05CBF(0)
      IFAIL = 0
      DO 20 I = 1, 5
*
         X = G05DHF(5,IFAIL)
*
         WRITE (NOUT,99999) X
   20 CONTINUE
      STOP
*
99999 FORMAT (1X,F10.4)
      END
```

### 9.2 Program Data

None.

## 9.3 Program Results

```
 G05DHF Example Program Results

     6.7995
     1.6156
     9.0290
     2.2949
     3.7902
```