

# NAG Fortran Library Routine Document

## G05DKF

**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

G05DKF returns a pseudo-random real number taken from the  $F$  (or Fisher's variance ratio) distribution with  $m$  and  $n$  degrees of freedom.

### 2 Specification

```
real FUNCTION G05DKF(M, N, IFAIL)
INTEGER          M, N, IFAIL
```

### 3 Description

The distribution has PDF (probability density function)

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

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

The routine returns the value

$$\frac{ny}{mz}$$

where  $y$  and  $z$  are generated by G05FFF from gamma distributions with parameters  $(\frac{1}{2}m, 2)$  and  $(\frac{1}{2}n, 2)$  respectively (i.e., from  $\chi^2$  distributions with  $m$  and  $n$  degrees of freedom).

### 4 References

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

### 5 Parameters

1: M – INTEGER *Input*

*On entry:* the first degree of freedom,  $m$ , of the distribution.

*Constraint:*  $M > 0$ .

2: N – INTEGER *Input*

*On entry:* the second degree of freedom,  $n$ , of the distribution.

*Constraint:*  $N > 0$ .

3: 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,  $M < 1$ .

IFAIL = 2

On entry,  $N < 1$ .

## 7 Accuracy

Not applicable.

## 8 Further Comments

The time taken by the routine increases with  $m$  and  $n$ .

## 9 Example

The example program prints the first five pseudo-random real numbers from the  $F$ -distribution with two and three degrees of freedom, generated by G05DKF 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.

```
*      G05DKF 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           G05DKF
EXTERNAL        G05DKF
*      .. External Subroutines ..
EXTERNAL        G05CBF, G05ZAF
*      .. Executable Statements ..
CALL G05ZAF('O')
WRITE (NOUT,*) 'G05DKF Example Program Results'
WRITE (NOUT,*)
CALL G05CBF(0)
IFAIL = 0
DO 20 I = 1, 5
*
*          X = G05DKF(2,3,IFAIL)
*
*          WRITE (NOUT,99999) X
20 CONTINUE
STOP
```

```
*  
99999 FORMAT (1X,F10.4)  
END
```

## 9.2 Program Data

None.

## 9.3 Program Results

G05DKF Example Program Results

```
0.1252  
10.8233  
0.7821  
0.8655  
0.5804
```

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