

G05DFF – 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

G05DFF returns a pseudo-random real number taken from a Cauchy distribution with median a and semi-interquartile range b .

2 Specification

```
real FUNCTION G05DFF(A, B)
real                A, B
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{1}{\pi b \left(1 + \left(\frac{x-a}{b}\right)^2\right)}$$

The routine returns the value

$$a + b \frac{2y_1 - 1}{y_2},$$

where y_1 and y_2 are a pair of consecutive pseudo-random numbers from a uniform distribution over (0,1), generated by G05CAF, such that

$$(2y_1 - 1)^2 + y_2^2 \leq 1.$$

4 References

- [1] Knuth D E (1981) *The Art of Computer Programming (Volume 2)* Addison–Wesley (2nd Edition)
- [2] Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Volume 1)* Griffin (3rd Edition)

5 Parameters

- 1: A — *real* *Input*
On entry: the median a , of the distribution.
- 2: B — *real* *Input*
On entry: the semi-interquartile range b , of the distribution. If B is negative, the distribution of the generated numbers – though not the actual sequence – is the same as if the absolute value of B were used.

6 Error Indicators and Warnings

None.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

The example program prints the first five pseudo-random real numbers from a Cauchy distribution with median 1.0 and semi-interquartile range 1.5, generated by G05DFF 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.

```

*      G05DFF 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
*      .. External Functions ..
      DOUBLE PRECISION G05DFF
      EXTERNAL         G05DFF
*      .. External Subroutines ..
      EXTERNAL         G05CBF, G05ZAF
*      .. Executable Statements ..
      CALL G05ZAF('0')
      WRITE (NOUT,*) 'G05DFF Example Program Results'
      WRITE (NOUT,*)
      CALL G05CBF(0)
      DO 20 I = 1, 5
*
*         X = G05DFF(1.0D0,1.5D0)
*
*         WRITE (NOUT,99999) X
20 CONTINUE
      STOP
*
99999 FORMAT (1X,F10.4)
      END

```

9.2 Program Data

None.

9.3 Program Results

G05DFF Example Program Results

```

4.9225
-0.7160
24.9342
-1.2143
1.6063

```