G05EZF – 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

G05EZF generates a pseudo-random multivariate Normal vector taken from a distribution described by a reference vector set up by G05EAF.

2 Specification

```
SUBROUTINE G05EZF(Z, N, R, NR, IFAIL)
INTEGER           N, NR, IFAIL
real              Z(N), R(NR)
```

3 Description

This routine is designed for use in conjunction with G05EAF. The description of G05EAF should be referred to for a specification of the operation of these two routines.

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: Z(N) — ***real*** array *Output*

On exit: the pseudo-random multivariate Normal vector generated by the routine.

2: N — INTEGER *Input*

On entry: the dimension, n, of the distribution. This must be the same as was set up in the reference vector by G05EAF.

Constraint: $\mathrm{N} \geq 1$.

3: R(NR) — ***real*** array *Input*

On entry: the reference vector as set up by G05EAF.

4: NR — INTEGER *Input*

On entry: the dimension of the array R as declared in the (sub)program from which G05EZF is called. It must be the same as the value of NR specified in the call to G05EAF to set up the reference vector.

Constraint: $\mathrm{NR} \geq (\mathrm{N}+1)(\mathrm{N}+2)/2$.

5: 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,

or N is not the same as when R was set up by G05EAF. This is likely to be due to corruption of R.

IFAIL = 2

On entry, NR < (N + 1)(N + 2)/2.

7 Accuracy

The accuracy is discussed in G05EAF.

8 Further Comments

The time taken by the routine is of the order

$$a + b \times n + c \times n^2$$

where a and b are appreciably (say 10-20 times) larger than c.

9 Example

The example program prints five pseudo-random observations from a bivariate Normal distribution with means vector

$$\begin{bmatrix} 1.0 \\ 2.0 \end{bmatrix}$$

and covariance matrix

$$\begin{bmatrix} 2.0 & 1.0 \\ 1.0 & 3.0 \end{bmatrix},$$

generated by G05EAF and G05EZF 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.

```
*     G05EZF Example Program Text
*     NAG Fortran SMP Library, Release 2.  NAG Copyright 2000.
*     .. Parameters ..
      INTEGER          N, NR, IC
      PARAMETER        (N=2,NR=(N+1)*(N+2)/2,IC=N)
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*     .. Local Scalars ..
      INTEGER          I, IFAIL, J
*     .. Local Arrays ..
      DOUBLE PRECISION A(N), C(IC,N), R(NR), Z(N)
*     .. External Subroutines ..
      EXTERNAL         G05CBF, G05EAF, G05EZF, G05ZAF
*     .. Executable Statements ..
```

```
      CALL G05ZAF('O')
      WRITE (NOUT,*) 'G05EZF Example Program Results'
      WRITE (NOUT,*)
      A(1) = 1.0D0
      A(2) = 2.0D0
      C(1,1) = 2.0D0
      C(2,2) = 3.0D0
      C(1,2) = 1.0D0
      C(2,1) = 1.0D0
      CALL G05CBF(0)
      IFAIL = 0
*
      CALL G05EAF(A,N,C,IC,0.01D0,R,NR,IFAIL)
*
      DO 20 I = 1, 5
*
         CALL G05EZF(Z,N,R,NR,IFAIL)
*
         WRITE (NOUT,99999) (Z(J),J=1,N)
   20 CONTINUE
      STOP
*
99999 FORMAT (1X,2F10.4)
      END
```

9.2 Program Data

None.

9.3 Program Results

```
 G05EZF Example Program Results

    1.7697    4.4481
    3.2678    3.0583
    3.1769    2.3651
   -0.1055    1.8395
    1.2933   -0.1850
```