

NAG Toolbox

nag_rand_dist_normal (g05sk)

1 Purpose

nag_rand_dist_normal (g05sk) generates a vector of pseudorandom numbers taken from a Normal (Gaussian) distribution with mean μ and variance σ^2 .

2 Syntax

```
[state, x, ifail] = nag_rand_dist_normal(n, xmu, var, state)
[state, x, ifail] = g05sk(n, xmu, var, state)
```

3 Description

The distribution has PDF (probability distribution function)

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right).$$

nag_rand_dist_normal (g05sk) uses the algorithm of Wichura (1988).

One of the initialization functions nag_rand_init_repeat (g05kf) (for a repeatable sequence if computed sequentially) or nag_rand_init_nonrepeat (g05kg) (for a non-repeatable sequence) must be called prior to the first call to nag_rand_dist_normal (g05sk).

4 References

Kendall M G and Stuart A (1969) *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin
 Knuth D E (1981) *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley
 Wichura (1988) Algorithm AS 241: the percentage points of the Normal distribution *Appl. Statist.* **37**
 477–484

5 Parameters

5.1 Compulsory Input Parameters

- 1: **n** – INTEGER
 n , the number of pseudorandom numbers to be generated.
Constraint: $n \geq 0$.
- 2: **xmu** – REAL (KIND=nag_wp)
 μ , the mean of the distribution.
- 3: **var** – REAL (KIND=nag_wp)
 σ^2 , the variance of the distribution.
Constraint: $\text{var} \geq 0.0$.

4: **state**(:) – INTEGER array

Note: the actual argument supplied **must** be the array **state** supplied to the initialization routines `nag_rand_init_repeat` (g05kf) or `nag_rand_init_nonrepeat` (g05kg).

Contains information on the selected base generator and its current state.

5.2 Optional Input Parameters

None.

5.3 Output Parameters

1: **state**(:) – INTEGER array

Contains updated information on the state of the generator.

2: **x**(**n**) – REAL (KIND=nag_wp) array

The n pseudorandom numbers from the specified Normal distribution.

3: **ifail** – INTEGER

ifail = 0 unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

Constraint: $\mathbf{n} \geq 0$.

ifail = 3

Constraint: $\mathbf{var} \geq 0.0$.

ifail = 4

On entry, **state** vector has been corrupted or not initialized.

ifail = -99

An unexpected error has been triggered by this routine. Please contact NAG.

ifail = -399

Your licence key may have expired or may not have been installed correctly.

ifail = -999

Dynamic memory allocation failed.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

This example prints five pseudorandom numbers from a Normal distribution with mean 1.0 and variance 1.5, generated by a single call to `nag_rand_dist_normal` (`g05sk`), after initialization by `nag_rand_init_repeat` (`g05kf`).

9.1 Program Text

```
function g05sk_example

fprintf('g05sk example results\n\n');

% Initialize the base generator to a repeatable sequence
seed = [nag_int(1762543)];
genid = nag_int(1);
subid = nag_int(1);
[state, ifail] = g05kf( ...
                    genid, subid, seed);

% Number of variates
n = nag_int(5);

% Parameters
xmu = 1;
var = 1.5;

% Generate variates from a Normal distribution
[state, x, ifail] = g05sk( ...
                    n, xmu, var, state);

disp('Variates');
disp(x);
```

9.2 Program Results

```
g05sk example results

Variates
  1.4272
 -0.5254
  1.8109
  2.0232
 -0.5380
```
