

NAG C Library Function Document

nag_rngs_normal (g05lac)

1 Purpose

nag_rngs_normal (g05lac) generates a vector of pseudo-random numbers taken from a Normal (Gaussian) distribution with mean μ and variance σ^2 .

2 Specification

```
void nag_rngs_normal (double xmu, double var, Integer n, double x[], Integer igen,
    Integer iseed[], NagError *fail)
```

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_rngs_normal (g05lac) uses the Box–Muller method.

One of the initialisation functions nag_rngs_init_repeatable (g05kbc) (for a repeatable sequence if computed sequentially) or nag_rngs_init_nonrepeatable (g05kcc) (for a non-repeatable sequence) must be called prior to the first call to nag_rngs_normal (g05lac).

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: | xmu – double | <i>Input</i> |
| | <i>On entry:</i> the mean, μ , of the distribution. | |
| 2: | var – double | <i>Input</i> |
| | <i>On entry:</i> the variance, σ^2 , of the distribution. | |
| | <i>Constraint:</i> var \geq 0.0. | |
| 3: | n – Integer | <i>Input</i> |
| | <i>On entry:</i> the number, n , of pseudo-random numbers to be generated. | |
| | <i>Constraint:</i> n \geq 0. | |
| 4: | x[dim] – double | <i>Output</i> |
| | Note: the dimension, dim , of the array x must be at least $\max(1, n)$. | |
| | <i>On exit:</i> the n pseudo-random numbers from the specified Normal distribution. | |

- 5: **igen** – Integer *Input*
On entry: must contain the identification number for the generator to be used to return a pseudo-random number and should remain unchanged following initialisation by a prior call to one of the functions `nag_rngs_init_repeatable` (g05kbc) or `nag_rngs_init_nonrepeatable` (g05kcc).
- 6: **iseed**[4] – Integer *Input/Output*
On entry: contains values which define the current state of the selected generator.
On exit: contains updated values defining the new state of the selected generator.
- 7: **fail** – NagError * *Input/Output*
The NAG error parameter (see the Essential Introduction).

6 Error Indicators and Warnings

NE_INT

On entry, **n** = $\langle value \rangle$.
Constraint: **n** ≥ 0 .

NE_REAL

On entry, **var** = $\langle value \rangle$.
Constraint: **var** ≥ 0.0 .

NE_BAD_PARAM

On entry, parameter $\langle value \rangle$ had an illegal value.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please consult NAG for assistance.

7 Accuracy

The generated numbers conform to a Normal distribution with an accuracy of $\sqrt{\textit{machine precision}}$.

8 Further Comments

None.

9 Example

The example program prints 5 pseudo-random numbers from a Normal distribution with mean 1.0 and variance 1.5, generated by a single call to `nag_rngs_normal` (g05lac), after initialisation by `nag_rngs_init_repeatable` (g05kbc).

9.1 Program Text

```
/* nag_rngs_normal(g05lac) Example Program.
 *
 * Copyright 2001 Numerical Algorithms Group.
 *
 * Mark 7, 2001.
 */

#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
```

```

#include <nagg05.h>

int main(void)
{
    /* Scalars */
    Integer i, igen, n;
    Integer exit_status=0;
    NagError fail;

    /* Arrays */
    double *x=0;
    Integer  iseed[4];

    INIT_FAIL(fail);
    Vprintf("g05lac Example Program Results\n\n");

    n = 5;
    /* Allocate memory */
    if ( !(x = NAG_ALLOC(n, double)) )
    {
        Vprintf("Allocation failure\n");
        exit_status = -1;
        goto END;
    }

    /* Initialise the seed to a repeatable sequence */
    iseed[0] = 1762543;
    iseed[1] = 9324783;
    iseed[2] = 42344;
    iseed[3] = 742355;

    /* igen identifies the stream. */
    igen = 1;
    g05kbc(&igen, iseed);
    g05lac(1.0, 1.5, n, x, igen, iseed, &fail);
    if (fail.code != NE_NOERROR)
    {
        Vprintf("Error from g05lac.\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    for (i = 1; i <= n; ++i)
    {
        Vprintf("%10.4f\n",  x[i - 1]);
    }
    END:
    if (x) NAG_FREE(x);
    return exit_status;
}

```

9.2 Program Data

None.

9.3 Program Results

g05lac Example Program Results

```

3.5652
0.1837
0.9297
-0.6421
0.6371

```
