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 $\mu$ and variance $\sigma^2$.

2 Specification

```c
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


5 Parameters

1: xmu – double

   Input

   On entry: the mean, $\mu$, of the distribution.

2: var – double

   Input

   On entry: the variance, $\sigma^2$, of the distribution.

   Constraint: var $\geq 0.0$.

3: n – Integer

   Input

   On entry: the number, $n$, of pseudo-random numbers to be generated.

   Constraint: $n \geq 0$.

4: x[dim] – double

   Output

   Note: the dimension, $\dim$, of the array $x$ must be at least max(1,n).

   On exit: the $n$ pseudo-random numbers from the specified Normal distribution.
igen – Integer

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).


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.

fail – NagError *

The NAG error parameter (see the Essential Introduction).

6 Error Indicators and Warnings

**NE_INT**

On entry, \( n = (\text{value}) \).
Constraint: \( n \geq 0 \).

**NE_REAL**

On entry, \( \text{var} = (\text{value}) \).
Constraint: \( \text{var} \geq 0.0 \).

**NE_BAD_PARAM**

On entry, parameter \( (\text{value}) \) 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 \( \sqrt{\text{machine precision}} \).

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

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

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


```c
#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

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5652</td>
</tr>
<tr>
<td>0.1837</td>
</tr>
<tr>
<td>0.9297</td>
</tr>
<tr>
<td>-0.6421</td>
</tr>
<tr>
<td>0.6371</td>
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</tbody>
</table>

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