

NAG C Library Function Document

nag_rngs_discrete_uniform (g05mac)

1 Purpose

nag_rngs_discrete_uniform (g05mac) generates a vector of pseudo-random integers uniformly distributed over the interval $[a, b]$.

2 Specification

```
void nag_rngs_discrete_uniform (Integer a, Integer b, Integer n, Integer x[],
    Integer igen, Integer iseed[], NagError *fail)
```

3 Description

nag_rngs_discrete_uniform (g05mac) generates the next n values y_i from a uniform (0,1) generator (see nag_rngs_basic (g05kac) for details) and applies the transformation

$$x_i = a + [(b - a + 1)y_i],$$

where $[z]$ is the integer part of the real value z . The function ensures that the values x_i lie in the closed interval $[a, b]$.

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_discrete_uniform (g05mac).

4 References

Knuth D E (1981) *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley

5 Parameters

- | | | |
|----|---|---------------------|
| 1: | a – Integer | <i>Input</i> |
| 2: | b – Integer | <i>Input</i> |
| | <i>On entry:</i> the end-points a and b of the uniform distribution. | |
| | <i>Constraint:</i> $\mathbf{a} \leq \mathbf{b}$. | |
| 3: | n – Integer | <i>Input</i> |
| | <i>On entry:</i> the number, n , of pseudo-random numbers to be generated. | |
| | <i>Constraint:</i> $\mathbf{n} \geq 0$. | |
| 4: | x [<i>dim</i>] – Integer | <i>Output</i> |
| | Note: the dimension, <i>dim</i> , of the array x must be at least $\max(1, \mathbf{n})$. | |
| | <i>On exit:</i> the n pseudo-random numbers from the specified uniform distribution. | |
| 5: | igen – Integer | <i>Input</i> |
| | <i>On entry:</i> 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 | <i>Input/Output</i> |
| | <i>On entry:</i> 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** \geq 0.

NE_INT_2

On entry, **a** = $\langle value \rangle$ and **b** = $\langle value \rangle$.
Constraint: **b** \geq **a**.

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

Not applicable.

8 Further Comments

None.

9 Example

The example program prints five pseudo-random integers from a discrete uniform distribution between -5 and 5 , generated by a single call to `nag_rngs_discrete_uniform` (g05mac), after initialisation by `nag_rngs_init_repeatable` (g05kbc).

9.1 Program Text

```
/* nag_rngs_discrete_uniform(g05mac) 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 igen, j, m;
    Integer exit_status=0;
    NagError fail;

    /* Arrays */
```

```
Integer *x=0;
Integer iseed[4];

INIT_FAIL(fail);
Vprintf("g05mac Example Program Results\n\n");

m = 5;
/* Allocate memory */
if ( !(x = NAG_ALLOC(m, Integer)) )
{
    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);

g05mac(-5, 5, m, x, igen, iseed, &fail);
if (fail.code != NE_NOERROR)
{
    Vprintf("Error from g05mac.\n%s\n", fail.message);
    exit_status = 1;
    goto END;
}
for (j = 0; j < m; ++j)
{
    Vprintf("%12ld\n", x[j]);
}
END:
if (x) NAG_FREE(x);
return exit_status;
}
```

9.2 Program Data

None.

9.3 Program Results

g05mac Example Program Results

```
-5
 5
-1
 3
 5
```
