NAG Library Function Document

nag_rand_uniform (g05sqc)

1 Purpose

nag_rand_uniform (g05sqc) generates a vector of pseudorandom numbers uniformly distributed over the interval $[a, b]$.

2 Specification

```
#include <nag.h>
#include <nagg05.h>
void nag_rand_uniform (Integer n, double a, double b, Integer state[],
     double x[], NagError *fail)
```

3 Description

If $a = 0$ and $b = 1$, nag_rand_uniform (g05sqc) returns the next n values y_i from a uniform $(0, 1]$ generator (see nag_rand_basic (g05sac) for details).

For other values of a and b, nag_rand_uniform (g05sqc) applies the transformation

$$x_i = a + (b - a)y_i.$$

The function ensures that the values x_i lie in the closed interval $[a, b]$.

One of the initialization functions nag_rand_init_repeatable (g05kfc) (for a repeatable sequence if computed sequentially) or nag_rand_init_nonrepeatable (g05kgc) (for a non-repeatable sequence) must be called prior to the first call to nag_rand_uniform (g05sqc).

4 References

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

5 Arguments

1: **n** – Integer *Input*

On entry: n, the number of pseudorandom numbers to be generated.

Constraint: **n** ≥ 0.

2: **a** – double *Input*

3: **b** – double *Input*

On entry: the end points a and b of the uniform distribution.

Constraint: **a** $\leq$ **b**.

4: **state**$[dim]$ – Integer *Communication Array*

Note: the dimension, dim, of this array is dictated by the requirements of associated functions that must have been previously called. This array MUST be the same array passed as argument **state** in the previous call to nag_rand_init_repeatable (g05kfc) or nag_rand_init_nonrepeatable (g05kgc).

On entry: contains information on the selected base generator and its current state.

On exit: contains updated information on the state of the generator.

5: **x**[**n**] – double *Output*

On exit: the n pseudorandom numbers from the specified uniform distribution.

6: **fail** – NagError * *Input/Output*

The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_BAD_PARAM

On entry, argument ⟨*value*⟩ had an illegal value.

NE_INT

On entry, **n** = ⟨*value*⟩.
Constraint: **n** ≥ 0.

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 contact NAG for assistance.

NE_INVALID_STATE

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

NE_REAL_2

On entry, **a** = ⟨*value*⟩ and **b** = ⟨*value*⟩.
Constraint: **b** ≥ **a**.

7 Accuracy

Not applicable.

8 Parallelism and Performance

nag_rand_uniform (g05sqc) is threaded by NAG for parallel execution in multithreaded implementations of the NAG Library.

Please consult the Users' Note for your implementation for any additional implementation-specific information.

9 Further Comments

Although y_i takes a value from the half closed interval $(0, 1]$ and $x_i = a + (b - a)y_i$, x_i is documented as taking values from the closed interval $[a, b]$. This is because for some values of a and b, nag_rand_uniform (g05sqc) may return a value of a due to numerical rounding.

10 Example

This example prints five pseudorandom numbers from a uniform distribution between -1.0 and 1.0, generated by a single call to nag_rand_uniform (g05sqc), after initialization by nag_rand_init_repeatable (g05kfc).

10.1 Program Text

```
/* nag_rand_uniform (g05sqc) Example Program.
 *
 * Copyright 2008, Numerical Algorithms Group.
 *
 * Mark 9, 2009.
 */
/* Pre-processor includes */
#include <stdio.h>
#include <math.h>
#include <nag.h>
#include <nag_stdlib.h>
#include <nagg05.h>

int main(void)
{
  /* Integer scalar and array declarations */
  Integer     exit_status = 0;
  Integer     i, lstate;
  Integer     *state = 0;

  /* NAG structures */
  NagError    fail;

  /* Double scalar and array declarations */
  double      *x = 0;

  /* Set the distribution parameters */
  double      a = -1.0e0;
  double      b = 1.0e0;

  /* Set the sample size */
  Integer     n = 5;

  /* Choose the base generator */
  Nag_BaseRNG genid = Nag_Basic;
  Integer     subid = 0;

  /* Set the seed */
  Integer     seed[] = { 1762543 };
  Integer     lseed = 1;

  /* Initialise the error structure */
  INIT_FAIL(fail);

  printf("nag_rand_uniform (g05sqc) Example Program Results\n\n");

  /* Get the length of the state array */
  lstate = -1;
  nag_rand_init_repeatable(genid, subid, seed, lseed, state, &lstate, &fail);
  if (fail.code != NE_NOERROR)
    {
      printf("Error from nag_rand_init_repeatable (g05kfc).\n%s\n",
              fail.message);
      exit_status = 1;
      goto END;
    }

  /* Allocate arrays */
  if (!(x = NAG_ALLOC(n, double)) ||
      !(state = NAG_ALLOC(lstate, Integer)))
    {
      printf("Allocation failure\n");
      exit_status = -1;
      goto END;
    }

  /* Initialise the generator to a repeatable sequence */
  nag_rand_init_repeatable(genid, subid, seed, lseed, state, &lstate, &fail);
  if (fail.code != NE_NOERROR)
```

```
    {
      printf("Error from nag_rand_init_repeatable (g05kfc).\n%s\n",
              fail.message);
      exit_status = 1;
      goto END;
    }

  /* Generate the variates */
  nag_rand_uniform(n, a, b, state, x, &fail);
  if (fail.code != NE_NOERROR)
    {
      printf("Error from nag_rand_uniform (g05sqc).\n%s\n",
              fail.message);
      exit_status = 1;
      goto END;
    }

  /* Display the variates*/
  for (i = 0; i < n; i++)
    printf("%10.4f\n", x[i]);

 END:
  NAG_FREE(x);
  NAG_FREE(state);

  return exit_status;
}
```

10.2 Program Data

None.

10.3 Program Results

```
nag_rand_uniform (g05sqc) Example Program Results

    0.2727
   -0.7870
    0.4921
    0.5965
   -0.7908
```