NAG C Library Function Document

nag_rngs_exp (g05ljc)

1 Purpose

nag_rngs_exp (g05ljc) generates a vector of pseudo-random numbers from a (negative) exponential distribution with mean \(a\).

2 Specification

```c
void nag_rngs_exp (double a, Integer n, double x[], Integer igen, Integer iseed[], NagError *fail)
```

3 Description

The exponential distribution has PDF (probability density function):

\[
f(x) = \begin{cases} \frac{1}{a}e^{-x/a} & \text{if } x > 0, \\ 0 & \text{otherwise.} \end{cases}
\]

nag_rngs_exp (g05ljc) returns the values

\[x_i = -a \ln y_i\]

where \(y_i\) are the next \(n\) numbers generated by a uniform (0,1) generator.

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_exp (g05ljc).

4 References


5 Parameters

1: \(a\) – double

\(On\ entry:\) the mean, \(a\), of the distribution.

\(Constraint:\ a > 0.0.\)

2: \(n\) – Integer

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

\(Constraint:\ n \geq 0.\)

3: \(x[\text{dim}]\) – double

\(Output\)

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

\(On\ exit:\) the \(n\) pseudo-random numbers from the specified exponential distribution.
4:  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).

    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.

6:  fail – NagError *  
    Input/Output
    The NAG error parameter (see the Essential Introduction).

6   Error Indicators and Warnings

NE_INT
    On entry, n = (value).
    Constraint: n ≥ 0.

NE_REAL
    On entry, a = (value).
    Constraint: a > 0.0.

NE_BAD_PARAM
    On entry, parameter (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
    Not applicable.

8   Further Comments
    None.

9   Example
    The example program prints five pseudo-random numbers from an exponential distribution with mean 1.0, 
    generated by a single call to nag_rngs_exp (g05ljc), after initialisation by nag_rngs_init_repeatable 
    (g05kbc).

9.1 Program Text

/* nag_rngs_exp(g05ljc) Example Program. 
   * Copyright 2001 Numerical Algorithms Group. 
   */
#include <stdio.h>
#include <nag.h>
#include <nag_stdlib.h>
```c
#include <nagg05.h>

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

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

    INIT_FAIL(fail);
    Vprintf("g05ljc Example Program Results\n\n");
    m=5;
    /* Allocate memory */
    if ( !(x = NAG_ALLOC(m, 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);
    g05ljc(1.0, m, x, igen, iseed, &fail);
    if (fail.code != NE_NOERROR)
    {
        Vprintf("Error from g05ljc.\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    for (j = 0; j < m; ++j)
    {
        Vprintf("%10.4f\n", x[j]);
    }

    END:
    if (x) NAG_FREE(x);
    return exit_status;
}
```

### 9.2 Program Data

None.

### 9.3 Program Results

g05ljc Example Program Results

| 2.4155 |
| 0.0503 |
| 0.9004 |
| 0.2968 |
| 0.0515 |