NAG C Library Function Document

nag_rngs_lognormal (g05lkc)

1 Purpose
nag_rngs_lognormal (g05lkc) generates a vector of pseudo-random numbers from a log-normal distribution with parameters $\mu$ and $\sigma^2$.

2 Specification

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

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} \exp\left(-\frac{(\ln x - \mu)^2}{2\sigma^2}\right) \text{ if } x > 0,$$

$$f(x) = 0 \text{ otherwise,}$$

i.e., $\ln x$ is normally distributed with mean $\mu$ and variance $\sigma^2$. nag_rngs_lognormal (g05lkc) evaluates $\exp y_i$, where the $y_i$ are generated by nag_rngs_normal (g05lac) from a Normal distribution with mean $\mu$ and variance $\sigma^2$.

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_lognormal (g05lkc).

4 References


5 Parameters

1: xmu – double
   
   *Input*
   
   On entry: the mean, $\mu$, of the distribution of $\ln x$.

2: var – double
   
   *Input*
   
   On entry: the variance, $\sigma^2$, of the distribution of $\ln x$.
   
   *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 log-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).

    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 *
    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, var = (value).
    Constraint: var ≥ 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 a log-normal distribution with mean 1.0
    and variance 2.0, generated by a single call to nag_rngs_lognormal (g05lkc), after initialisation by
    nag_rngs_init_repeatable (g05kbc).

9.1 Program Text
    /* nag_rngs_lognormal(g05lkc) 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("g05lkc 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);
    g05lkc(1.0, 2.0, m, x, igen, iseed, &fail);
    if (fail.code != NE_NOERROR)
    {
        Vprintf("Error from g05lkc.\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

g05lkc Example Program Results

<table>
<thead>
<tr>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.5633</td>
</tr>
<tr>
<td>1.0591</td>
</tr>
<tr>
<td>2.5065</td>
</tr>
<tr>
<td>0.4082</td>
</tr>
<tr>
<td>1.7877</td>
</tr>
</tbody>
</table>

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[NP3645/7] g05lkc.3 (last)