

NAG C Library Function Document

nag_rngs_f (g05ldc)

1 Purpose

nag_rngs_f (g05ldc) generates a vector of pseudo-random numbers taken from a F (or Fisher's variance ratio) distribution with μ and ν degrees of freedom.

2 Specification

```
void nag_rngs_f (Integer df1, Integer df2, Integer n, double x[], Integer igen,
                Integer iseed[], NagError *fail)
```

3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{\left(\frac{\mu+\nu-2}{2}\right)! x^{\frac{1}{2}\mu-1}}{\left(\frac{1}{2}\mu-1\right)!\left(\frac{1}{2}\nu-1\right)!\left(1+\frac{\mu}{\nu}x\right)^{\frac{1}{2}(\mu+\nu)}} \times \left(\frac{\mu}{\nu}\right)^{\frac{1}{2}\mu} \quad \text{if } x > 0,$$

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

nag_rngs_f (g05ldc) calculates the values

$$\frac{\nu y_i}{\mu z_i}, \quad i = 1, \dots, n,$$

where y_i and z_i are generated by nag_rngs_gamma (g05lfc) from gamma distributions with parameters $(\frac{1}{2}\mu, 2)$ and $(\frac{1}{2}\nu, 2)$ respectively (i.e., from χ^2 distributions with μ and ν degrees of freedom).

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_f (g05ldc).

4 References

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

5 Parameters

- | | | |
|----|--|---------------|
| 1: | df1 – Integer | <i>Input</i> |
| | <i>On entry:</i> the number of degrees of freedom, μ , of the distribution. <i>Constraint:</i> df1 \geq 1. | |
| 2: | df2 – Integer | <i>Input</i> |
| | <i>On entry:</i> the number of degrees of freedom, ν , of the distribution. <i>Constraint:</i> df2 \geq 1. | |
| 3: | n – Integer | <i>Input</i> |
| | <i>On entry:</i> the number, n , of pseudo-random numbers to be generated. <i>Constraint:</i> n \geq 0. | |
| 4: | x [<i>dim</i>] – double | <i>Output</i> |
| | Note: the dimension, <i>dim</i> , of the array x must be at least $\max(1, \mathbf{n})$. | |

On exit: the n pseudo-random numbers from the specified F 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).
- 6: **iseed**[4] – Integer *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.
- 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** ≥ 0 .

On entry, **df2** = $\langle value \rangle$.
Constraint: **df2** ≥ 1 .

On entry, **df1** = $\langle value \rangle$.
Constraint: **df1** ≥ 1 .

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

The time taken by `nag_rngs_f` (g05ldc) increases with μ and ν .

9 Example

The example program prints five pseudo-random numbers from a F -distribution with two and three degrees of freedom, generated by a single call to `nag_rngs_f` (g05ldc), after initialisation by `nag_rngs_init_repeatable` (g05kbc).

9.1 Program Text

```
/* nag_rngs_f(g05ldc) 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 i, igen, n ;
    Integer exit_status=0;
    NagError fail;

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

    INIT_FAIL(fail);
    Vprintf("g05ldc 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);
    g05ldc(2, 3, n, x, igen, iseed, &fail);
    if (fail.code != NE_NOERROR)
    {
        Vprintf("Error from g05ldc.\n%s\n", fail.message);
        exit_status = 1;
        goto END;
    }
    for (i = 0; i < n; ++i)
    {
        Vprintf("%10.4f\n", x[i]);
    }
    END:
    if (x) NAG_FREE(x);
    return exit_status;
}

```

9.2 Program Data

None.

9.3 Program Results

g05ldc Example Program Results

```

14.2359
 0.8889
 0.4055
 2.3299
 0.0689

```
