

NAG Toolbox

nag_rand_dist_f (g05sh)

1 Purpose

nag_rand_dist_f (g05sh) generates a vector of pseudorandom numbers taken from an F (or Fisher's variance ratio) distribution with μ and ν degrees of freedom.

2 Syntax

```
[state, x, ifail] = nag_rand_dist_f(n, df1, df2, state)
```

```
[state, x, ifail] = g05sh(n, df1, df2, state)
```

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_rand_dist_f (g05sh) calculates the values

$$\frac{\nu y_i}{\mu z_i}, \quad i = 1, 2, \dots, n,$$

where y_i and z_i are generated by nag_rand_dist_gamma (g05sj) 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 initialization functions nag_rand_init_repeat (g05kf) (for a repeatable sequence if computed sequentially) or nag_rand_init_nonrepeat (g05kg) (for a non-repeatable sequence) must be called prior to the first call to nag_rand_dist_f (g05sh).

4 References

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

5 Parameters

5.1 Compulsory Input Parameters

1: **n** – INTEGER

n , the number of pseudorandom numbers to be generated.

Constraint: **n** ≥ 0 .

2: **df1** – INTEGER

μ , the number of degrees of freedom of the distribution.

Constraint: **df1** ≥ 1 .

3: **df2** – INTEGER

ν , the number of degrees of freedom of the distribution.

Constraint: **df2** \geq 1.

4: **state**(:) – INTEGER array

Note: the actual argument supplied **must** be the array **state** supplied to the initialization routines `nag_rand_init_repeat` (g05kf) or `nag_rand_init_nonrepeat` (g05kg).

Contains information on the selected base generator and its current state.

5.2 Optional Input Parameters

None.

5.3 Output Parameters

1: **state**(:) – INTEGER array

Contains updated information on the state of the generator.

2: **x**(**n**) – REAL (KIND=nag_wp) array

The n pseudorandom numbers from the specified F -distribution.

3: **ifail** – INTEGER

ifail = 0 unless the function detects an error (see Section 5).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

Constraint: **n** \geq 0.

ifail = 2

Constraint: **df1** \geq 1.

ifail = 3

Constraint: **df2** \geq 1.

ifail = 4

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

ifail = -99

An unexpected error has been triggered by this routine. Please contact NAG.

ifail = -399

Your licence key may have expired or may not have been installed correctly.

ifail = -999

Dynamic memory allocation failed.

7 Accuracy

Not applicable.

8 Further Comments

The time taken by `nag_rand_dist_f` (g05sh) increases with μ and ν .

9 Example

This example prints five pseudorandom numbers from an F -distribution with two and three degrees of freedom, generated by a single call to `nag_rand_dist_f` (g05sh), after initialization by `nag_rand_init_repeat` (g05kf).

9.1 Program Text

```
function g05sh_example

fprintf('g05sh example results\n\n');

% Initialize the base generator to a repeatable sequence
seed = [nag_int(1762543)];
genid = nag_int(1);
subid = nag_int(1);
[state, ifail] = g05kf( ...
                    genid, subid, seed);

% Number of variates
n = nag_int(5);

% Parameters
df1 = nag_int(2);
df2 = nag_int(3);

% Generate variates from an F-distribution
[state, x, ifail] = g05sh( ...
                    n, df1, df2, state);

disp('Variates');
disp(x);
```

9.2 Program Results

```
g05sh example results

Variates
    1.4401
    1.8083
    0.3638
    0.5464
    4.0895
```
