

NAG Toolbox

nag_rand_dist_vonmises (g05sr)

1 Purpose

nag_rand_dist_vonmises (g05sr) generates a vector of pseudorandom numbers from a von Mises distribution with concentration parameter κ .

2 Syntax

```
[state, x, ifail] = nag_rand_dist_vonmises(n, vk, state)
[state, x, ifail] = g05sr(n, vk, state)
```

3 Description

The von Mises distribution is a symmetric distribution used in the analysis of circular data. The PDF (probability density function) of this distribution on the circle with mean direction $\mu_0 = 0$ and concentration parameter κ , can be written as:

$$f(\theta) = \frac{e^{\kappa \cos \theta}}{2\pi I_0(\kappa)},$$

where θ is reduced modulo 2π so that $-\pi \leq \theta < \pi$ and $\kappa \geq 0$. For very small κ the distribution is almost the uniform distribution, whereas for $\kappa \rightarrow \infty$ all the probability is concentrated at one point.

The n variates, $\theta_1, \theta_2, \dots, \theta_n$, are generated using an envelope rejection method with a wrapped Cauchy target distribution as proposed by Best and Fisher (1979) and described by Dagpunar (1988).

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_vonmises (g05sr).

4 References

Best D J and Fisher N I (1979) Efficient simulation of the von Mises distribution *Appl. Statist.* **28** 152–157

Dagpunar J (1988) *Principles of Random Variate Generation* Oxford University Press

Mardia K V (1972) *Statistics of Directional Data* Academic Press

5 Parameters

5.1 Compulsory Input Parameters

1: **n** – INTEGER

n , the number of pseudorandom numbers to be generated.

Constraint: $n \geq 0$.

2: **vk** – REAL (KIND=nag_wp)

κ , the concentration parameter of the required von Mises distribution.

Constraint: $0.0 < \mathbf{vk} \leq \sqrt{x02a1}/2.0$.

3: **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 von Mises 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: $\mathbf{n} \geq 0$.

ifail = 2

On entry, $\mathbf{vk} \leq 0.0$ or \mathbf{vk} too large:

ifail = 3

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

For a given number of random variates the generation time increases slightly with increasing κ .

9 Example

This example prints the first five pseudorandom numbers from a von Mises distribution with $\kappa = 1.0$, generated by a single call to `nag_rand_dist_vonmises` (g05sr), after initialization by `nag_rand_init_repeat` (g05kf).

9.1 Program Text

```
function g05sr_example

fprintf('g05sr 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
vk = 1;

% Generate variates from von Mises distribution
[state, x, ifail] = g05sr( ...
                    n, vk, state);

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

9.2 Program Results

```
g05sr example results

Variates
  1.2947
 -1.9542
 -0.6464
 -1.4172
  1.2536
```
