NAG Toolbox for MATLAB

g05lp

1 Purpose

g05lp generates a vector of pseudo-random numbers from a von Mises distribution with concentration parameter κ.

2 Syntax

```
[x, iseed, ifail] = g05lp(vk, n, igen, iseed)
```

3 Description

The von Mises distribution is a symmetric distribution used in the analysis of circular data. The probability density function of this distribution on the circle with mean direction $\mu_0 = 0$ and concentration parameter kappa, 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, $\theta_1, \theta_2, \ldots, \theta_n$, 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 g05kb (for a repeatable sequence if computed sequentially) or g05kc (for a non-repeatable sequence) must be called prior to the first call to g05lp.

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: **vk – double scalar**

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

Constraint: **vk** > 0.0.

2: **n – int32 scalar**

n, the number of pseudo-random numbers to be generated.

Constraint: **n** ≥ 0.

3: **igen – int32 scalar**

Must contain the identification number for the generator to be used to return a pseudo-random number and should remain unchanged following initialization by a prior call to g05kb or g05kc.

4: **iseed**(4) **– int32 array**

Contains values which define the current state of the selected generator.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **x**$(*)$ **– double array**

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

The n pseudo-random numbers from the specified von Mises distribution.

2: **iseed**(4) **– int32 array**

Contains updated values defining the new state of the selected generator.

3: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail $= 1$

On entry, **vk** ≤ 0.0.

ifail $= 2$

On entry, **n** < 0.

7 Accuracy

Not applicable.

8 Further Comments

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

If **vk** is supplied too large (i.e., **vk** $> \sqrt{(}$x02al()$)$) then floating-point overflow will occur in internal calculation.

9 Example

```
vk = 1;
n = int32(5);
igen = int32(1);
iseed = [int32(1762543);
     int32(9324783);
     int32(42344);
     int32(742355)];
[x, iseedOut, ifail] = g05lp(vk, n, igen, iseed)
```

```
x =
   -1.1339
   -2.5880
   -0.6178
    0.0519
   -0.9584
iseedOut =
    16736192
     9444300
    11864102
    12267461
ifail =
           0
```