

NAG Toolbox for MATLAB

g05md

1 Purpose

g05md generates a vector of pseudo-random integers from the discrete logarithmic distribution with parameter a .

2 Syntax

```
[x, iseed, r, ifail] = g05md(mode, a, n, igen, iseed, r)
```

3 Description

g05md generates n integers x_i from a discrete logarithmic distribution, where the probability of $x_i = I$ is

$$P(x_i = I) = -\frac{(a^I)}{(I \times \log(1 - a))} \quad I = 1, 2, \dots,$$

where $0 < a < 1$.

The variates can be generated with or without using a search table and index. If a search table is used then it is stored with the index in a reference vector and subsequent calls to g05md with the same parameter value can then use this reference vector to generate further variates.

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 g05md.

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: **mode** – int32 scalar

A code for selecting the operation to be performed by the function:

mode = 0

Set up reference vector only.

mode = 1

Generate variates using reference vector set up in a prior call to g05md.

mode = 2

Set up reference vector and generate variates.

mode = 3

Generate variates without using the reference vector.

Constraint: $0 \leq \text{mode} \leq 3$.

2: **a** – double scalar

The parameter a of the logarithmic distribution.

Constraint: $0.0 < a < 1.0$.

- 3: **n – int32 scalar**
 n , the number of pseudo-random numbers to be generated.
Constraint: $n \geq 1$.
- 4: **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.
- 5: **iseed(4) – int32 array**
 Contains values which define the current state of the selected generator.
- 6: **r(nr) – double array**
 If **mode** = 1, the reference vector from the previous call to g05md.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

nr

5.4 Output Parameters

- 1: **x(n) – int32 array**
 The n pseudo-random numbers from the specified logarithmic distribution.
- 2: **iseed(4) – int32 array**
 Contains updated values defining the new state of the selected generator.
- 3: **r(nr) – double array**
 The reference vector.
- 4: **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, **n** < 1.

ifail = 2

On entry, **nr** is too small when **mode** = 0 or 2 (see Section 5).

ifail = 3

On entry, **a** ≤ 0.0
 or **a** ≥ 1.0.

ifail = 4

On entry, **mode** < 0
or **mode** > 3.

ifail = 5

mode = 0 or 2 and **a** is so close to 1 that **nr** would have to be larger than the largest representable integer. Use **mode** = 3 in this case.

ifail = 6

a is not the same as when **r** was set up in a previous call with **mode** = 0 or 2.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
mode = int32(3);  
a = 0.9999;  
n = int32(10);  
igen = int32(1);  
iseed = [int32(1762543);  
         int32(9324783);  
         int32(42344);  
         int32(742355)];  
r = zeros(1, 1);  
[x, iseedOut, rOut, ifail] = g05md(mode, a, n, igen, iseed, r)
```

```
x =  
    262  
    21  
   8546  
    737  
     1  
     1  
    16  
   197  
    53  
     3  
iseedOut =  
   7198201  
   6860924  
   8806996  
   4852644  
rOut =  
     0  
ifail =  
     0
```