

# NAG Toolbox for MATLAB

## g05mk

### 1 Purpose

g05mk generates a vector of pseudo-random integers from the discrete Poisson distribution with mean  $\lambda$ .

### 2 Syntax

```
[x, iseed, r, ifail] = g05mk(mode, lambda, n, igen, iseed, r)
```

### 3 Description

g05mk generates  $n$  integers  $x_i$  from a discrete Poisson distribution with mean  $\lambda$ , where the probability of  $x_i = I$  is

$$P(x_i = I) = \frac{\lambda^I \times e^{-\lambda}}{I!}, \quad I = 0, 1, \dots,$$

where  $0 \leq \lambda$ .

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 g05mk with the same parameter values can then use this reference vector to generate further variates. The reference array is found using a recurrence relation if  $\lambda$  is less than 50 and by Stirling's formula otherwise.

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 g05mk.

### 4 References

Kendall M G and Stuart A 1969 *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin

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 g05mk.

**mode** = 2

Set up reference vector and generate variates.

**mode** = 3

Generate variates without using the reference vector.

*Constraint:*  $0 \leq \mathbf{mode} \leq 3$ .

2: **lambda – double scalar**

The mean  $\lambda$  of the Poisson distribution.

*Constraint:* **lambda**  $\geq 0.0$ .

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 g05mk.

**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 Poisson 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, **lambda** < 0.0.

**ifail** = 4

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

**ifail** = 5

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

**ifail** = 6

**lambda** 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(0);
lambda = 20;
n = int32(10);
igen = int32(1);
iseed = [int32(1762543);
         int32(9324783);
         int32(42344);
         int32(742355)];
r = zeros(120, 1);
[x, iseedOut, rOut, ifail] = g05mk(mode, lambda, n, igen, iseed, r)
```

```
x =
0
0
0
0
0
0
0
0
0
0
iseedOut =
1762543
9324783
42344
742355
rOut =
array elided
ifail =
0
```