NAG Toolbox for MATLAB

g05me

1 Purpose

g05me generates a vector of pseudo-random integers, each from a discrete Poisson distribution with differing parameter λ.

2 Syntax

```
[x, iseed, ifail] = g05me(vlamda, igen, iseed, 'm', m)
```

3 Description

g05me generates m integers x_j, each from a discrete Poisson distribution with mean λ_j, where the probability of $x_j = I$ is

$$P(x_j = I) = \frac{\lambda_j^I \times e^{-\lambda_j}}{I!}, \qquad I = 0, 1, \ldots,$$

where

$$0 \leq \lambda_j, \qquad j = 1, 2, \ldots, m.$$

The methods used by this function have low set up times and are designed for efficient use when the value of the parameter λ changes during the simulation. For large samples from a distribution with fixed λ using g05mk to set up and use a reference vector may be more efficient.

When $\lambda < 7.5$ the product of uniforms method is used, see for example Dagpunar 1988. For larger values of λ an envelope rejection method is used with a target distribution:

$$f(x) = \tfrac{1}{3} \qquad \text{if } |x| \leq 1,$$

$$f(x) = \tfrac{1}{3}|x|^{-3} \quad \text{otherwise.}$$

This distribution is generated using a ratio of uniforms method. A similar approach has also been suggested by Ahrens and Dieter 1989. The basic method is combined with quick acceptance and rejection tests given by Maclaren 1990. For values of $\lambda \geq 87$ Stirling's approximation is used in the computation of the Poisson distribution function, otherwise tables of factorials are used as suggested by Maclaren 1990.

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 g05me.

4 References

Ahrens J H and Dieter U 1989 A convenient sampling method with bounded computation times for Poisson distributions *Amer. J. Math. Management Sci.* 1–13

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

Maclaren N M 1990 A Poisson random number generator *Personal Communication*

5 Parameters

5.1 Compulsory Input Parameters

1: **vlamda**(**m**) – **double array**

The means, λ_j, for $j = 1, 2, \ldots,$ **m**, of the Poisson distributions.

Constraint: $0.0 \leq$ **vlamda**$(j) \leq$ MAXINT$/2$, where MAXINT is the largest integer representable on the machine (see x02bb).

2: **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.

3: **iseed**(**4**) – **int32 array**

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

5.2 Optional Input Parameters

1: **m – int32 scalar**

Default: The dimension of the arrays **vlamda**, **x**. (An error is raised if these dimensions are not equal.)

m, the number of Poisson distributions for which pseudo-random variates are required.

Constraint: **m** ≥ 1.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **x**(**m**) – **int32 array**

The *m* pseudo-random numbers from the specified Poisson distributions.

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, **m** < 1.

ifail $= 2$

On entry, **vlamda**$(j) < 0.0$ for at least one value of *j*.

ifail $= 3$

On entry, $2 \times$ **vlamda**$(j) >$ MAXINT for at least one value of *j*.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
vlamda = [0.5;
     5;
     10;
     500;
     1000];
igen = int32(1);
iseed = [int32(1762543);
     int32(9324783);
     int32(423442);
     int32(742355)];
[x, iseedOut, ifail] = g05me(vlamda, igen, iseed)
```

```
x =
           1
           3
          13
         482
        1001
iseedOut =
     2192183
    10954283
     5052894
     9684925
ifail =
           0
```