

NAG Toolbox for MATLAB

g05dr

1 Purpose

g05dr returns a pseudo-random integer variate from a Poisson distribution with mean λ .

2 Syntax

```
[result, ifail] = g05dr(alamda)
```

3 Description

The distribution of a Poisson random variable X is given by

$$P(X = x) = \frac{\lambda^x e^{-\lambda}}{x!} \quad \text{if } x = 0, 1, 2, \dots$$

$$P(X = x) = 0 \quad \text{otherwise.}$$

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 g05ec to set up a reference vector for subsequent use by g05ey 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:

$$f(x) = \frac{1}{3} \quad \text{if } |x| \leq 1$$

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

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.

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: **alamda** – double scalar

λ , the parameter of the distribution.

Constraint: **alamda** > 0.0 and $2 \times \mathbf{alamda} \leq \mathbf{MAXINT}$, where MAXINT is the largest integer representable on the machine (see x02bb).

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **result** – int32 scalar

The result of the function.

2: **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, **alamda** $\leq$ 0.0.

ifail = 2

On entry, $2 \times \mathbf{alamda} > \mathbf{MAXINT}$.

7 Accuracy

Not applicable.

8 Further Comments

The methods used by g05dr 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 g05ec to set up a reference vector for subsequent use by g05ey may be more efficient.

9 Example

```
alamda = 1;  
g05za('O');  
g05cb(int32(0));  
[result, ifail] = g05dr(alamda)
```

```
result =  
        1  
ifail =  
        0
```