NAG Toolbox for MATLAB

g05lf

1 Purpose

g05lf generates a vector of pseudo-random numbers taken from a gamma distribution with a and b.

2 Syntax

```
[x, iseed, ifail] = g05lf(a, b, n, igen, iseed)
```

3 Description

The gamma distribution has PDF (probability density function)

$$f(x) = \frac{1}{b^a \Gamma(a)} x^{a-1} e^{-x/b} \quad \text{if } 0 \leq x; \qquad a, b > 0.0$$

$$f(x) = 0 \qquad \text{otherwise.}$$

One of three algorithms is used to generate the variates depending upon the value of a:

(i) if $a < 1$, a switching algorithm described by Dagpunar 1988 (called G6) is used. The target distributions are $f_1(x) = cax^{a-1}/t^a$ and $f_2(x) = (1-c)e^{-(x-t)}$, where $c = t/\left(t + ae^{-t}\right)$, and the switching parameter, t, is taken as $1 - a$. This is similar to Ahrens and Dieter's GS algorithm (see Ahrens and Dieter 1974) in which $t = 1$;

(ii) if $a = 1$, the gamma distribution reduces to the exponential distribution and the method based on the logarithmic transformation of a uniform random variate is used;

(iii) if $a > 1$, the algorithm given by Best 1978 is used. This is based on using a Student's t-distribution with two degrees of freedom as the target distribution in an envelope rejection method.

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 g05lf.

4 References

Ahrens J H and Dieter U 1974 Computer methods for sampling from gamma, beta, Poisson and binomial distributions *Computing* **12** 223–46

Best D J 1978 Letter to the Editor *Appl. Statist.* **27** 181

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

Hastings N A J and Peacock J B 1975 *Statistical Distributions* Butterworths

5 Parameters

5.1 Compulsory Input Parameters

1: **a – double scalar**

a, the parameter of the gamma distribution.

Constraint: **a** > 0.0.

2: **b – double scalar**

b, the parameter of the gamma distribution.

Constraint: **b** > 0.0.

3: **n – int32 scalar**

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

Constraint: $\mathbf{n} \geq 0$.

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.

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 gamma 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, $\mathbf{a} \leq 0.0$.

ifail $= 2$

On entry, $\mathbf{b} \leq 0.0$.

ifail $= 3$

On entry, $\mathbf{n} < 0$.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
a = 5;
b = 1;
n = int32(5);
igen = int32(1);
iseed = [int32(1762543);
     int32(9324783);
     int32(42344);
     int32(742355)];
[x, iseedOut, ifail] = g05lf(a, b, n, igen, iseed)
```

```
x =
    3.2806
    4.6512
    4.0683
    4.6252
    7.6745
iseedOut =
     2192183
    10954283
       67092
     9684925
ifail =
           0
```