

NAG Toolbox for MATLAB

g05ff

1 Purpose

g05ff generates a vector of pseudo-random variates from a gamma distribution with parameters a and b .

2 Syntax

```
[x, ifail] = g05ff(a, b, n)
```

3 Description

The gamma distribution has PDF (probability density function):

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

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

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

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 $c = t/(t + ae^{-t})$, 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 $t = 1$.

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.

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.

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: $n \geq 1$.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **x(n) – double array**

The n pseudo-random variates from the specified gamma distribution.

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, $a \leq 0.0$,
or $b \leq 0.0$,
or $n < 1$.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

```
a = 5;  
b = 1;  
n = int32(5);  
g05za('O');  
g05cb(int32(0));  
[x, ifail] = g05ff(a, b, n)
```

```
x =  
    6.7603  
    2.9943  
    8.3800
```

```
      4.5740  
      4.9672  
ifail =  
      0
```
