

NAG Toolbox for MATLAB

g05mc

1 Purpose

g05mc generates a vector of pseudo-random integers from the discrete negative binomial distribution with parameter m and probability p of success at a trial.

2 Syntax

```
[x, iseed, r, ifail] = g05mc(mode, m, p, n, igen, iseed, r)
```

3 Description

g05mc generates n integers x_i from a discrete negative binomial distribution, where the probability of $x_i = I$ (I successes before m failures) is

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

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 g05mc with the same parameter value can then use this reference vector to generate further variates.

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 g05mc.

4 References

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 g05mc.

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: **m** – int32 scalar

m , the number of failures of the distribution.

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

3: **p – double scalar**

The parameter p of the negative binomial distribution representing the probability of success at a single trial.

Constraint: $0.0 \leq \mathbf{p} < 1.0$.

4: **n – int32 scalar**

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

Constraint: $\mathbf{n} \geq 1$.

5: **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.

6: **iseed(4) – int32 array**

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

7: **r(nr) – double array**

If **mode** = 1, the reference vector from the previous call to g05mc.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

nr

5.4 Output Parameters1: **x(n) – int32 array**

The n pseudo-random numbers from the specified negative binomial 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, $\mathbf{n} < 1$.

ifail = 2

On entry, **nr** is too small when **mode** = 0 or 2 (see Section 5).

ifail = 3

On entry, **p** < 0.0
or **p** ≥ 1.0.

ifail = 4

On entry, **m** < 0.

ifail = 5

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

ifail = 6

mode = 0 or 2 and **p** is so close to 1 that **nr** would have to be larger than the largest representable integer. Use **mode** = 3 in this case.

ifail = 7

p or **m** 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(3);
m = int32(60);
p = 0.999;
n = int32(20);
igen = int32(1);
iseed = [int32(1762543);
         int32(9324783);
         int32(42344);
         int32(742355)];
r = zeros(1, 1);
[x, iseedOut, rOut, ifail] = g05mc(mode, m, p, n, igen, iseed, r)
```

```
x =
    49822
    73300
    57798
    64791
    73197
    58394
    61279
    57579
    56346
    70705
    59782
    58087
    61213
    81333
    47030
    57082
    67922
```

```
          56991
          46611
          62691
iseedOut =
          7198201
          6860924
          8806996
          4852644
rOut =
0
ifail =
          0
```
