

NAG Toolbox for MATLAB

g05ml

1 Purpose

g05ml generates a vector of pseudo-random integers from the discrete hypergeometric distribution of the number of specified items in a sample of size l , taken from a population of size n with m specified items in it.

2 Syntax

```
[x, iseed, r, ifail] = g05ml(mode, ns, np, m, n, igen, iseed, r)
```

3 Description

g05ml generates n integers x_i from a discrete hypergeometric distribution, where the probability of $x_i = I$ is

$$P(i = I) = \frac{l!m!(n-l)!(n-m)!}{l!(l-I)!(m-I)!(n-m-l+I)!n!} \quad \text{if } I = \max(0, m+l-n), \dots, \min(l, m),$$

$$P(i = I) = 0 \quad \text{otherwise.}$$

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 g05ml with the same parameter values can then use this reference vector to generate further variates. The reference array is generated by a recurrence relation if $lm(n-l)(n-m) < 50n^3$, otherwise Stirling's approximation is used.

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 g05ml.

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 g05ml.

mode = 2

Set up reference vector and generate variates.

mode = 3

Generate variates without using the reference vector.

Constraint: $0 \leq \text{mode} \leq 3$.

- 2: **ns – int32 scalar**
 l , the sample size of the hypergeometric distribution.
Constraint: $0 \leq \mathbf{ns} \leq \mathbf{np}$.
- 3: **np – int32 scalar**
 n , the population size of the hypergeometric distribution.
Constraint: $\mathbf{np} \geq 0$.
- 4: **m – int32 scalar**
 m , the number of specified items of the hypergeometric distribution.
Constraint: $0 \leq \mathbf{m} \leq \mathbf{np}$.
- 5: **n – int32 scalar**
the number of pseudo-random numbers to be generated.
Constraint: $\mathbf{n} \geq 1$.
- 6: **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.
- 7: **iseed(4) – int32 array**
Contains values which define the current state of the selected generator.
- 8: **r(nr) – double array**
If **mode** = 1, the reference vector from the previous call to g05ml.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

nr

5.4 Output Parameters

- 1: **x(n) – int32 array**
The n pseudo-random numbers from the specified hypergeometric 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, **n** < 1.

ifail = 2

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

ifail = 3

On entry, **np** < 0.

ifail = 4

On entry, **m** > **np**,
or **m** < 0.

ifail = 5

On entry, **ns** > **np**,
or **ns** < 0.

ifail = 6

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

ifail = 7

On entry, at least one of **ns**, **np** 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(2);
ns = int32(500);
np = int32(1000);
m = int32(900);
n = int32(20);
igen = int32(1);
iseed = [int32(1762543);
         int32(9324783);
         int32(42344);
         int32(742355)];
r = zeros(200, 1);
[igen, iseed] = g05kb(igen, iseed);
[x, iseedOut, rOut, ifail] = g05ml(mode, ns, np, m, n, igen, iseed, r)
```

```
x =
    444
```

```
458
449
453
458
449
451
449
448
456
450
449
451
462
442
448
455
448
441
452
iseedOut =
    7198201
    6860924
    8806996
    4852644
rOut =
    array elided
ifail =
    0
```
