NAG Toolbox for MATLAB

g05ee

1 Purpose

g05ee sets up the reference vector **r** for a negative binomial distribution of the number of successes before n failures, where each trial has probability of success p.

2 Syntax

```
[r, ifail] = g05ee(n, p, nr)
```

3 Description

g05ee sets up a reference vector for use in g05ey. Together these functions produce random numbers from the observation defined by:

$$P(I = i) = \frac{(n+i-1)!}{i!(n-1)!}p^i(1-p)^n \quad \text{if} \qquad i = 0, 1, \ldots,$$
$$P(I = i) = 0 \qquad\qquad \text{otherwise.}$$

The reference array is generated by a recurrence relation if $np < 50$; otherwise Stirling's approximation is used.

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: **n – int32 scalar**

n, the number of failures of the distribution.

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

2: **p – double scalar**

p, the probability of success of the distribution.

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

3: **nr – int32 scalar**

Suggested value: $\mathbf{nr} = 20 + \left(20\sqrt{\mathbf{n} \times \mathbf{p}} + 30 \times \mathbf{p}\right)/(1 - \mathbf{p})$ approximately (for optimum efficiency in g05ey).

Constraint:

$$\mathbf{nr} > \quad \text{int}\left(\frac{\mathbf{n}\times\mathbf{p}+7.15\sqrt{\mathbf{n}\times\mathbf{p}}+20.15\times\mathbf{p}}{1-\mathbf{p}} + 8.5\right)$$
$$- \overset{pmatrix}{\max}\left(0, \text{int}\left(\frac{\mathbf{n}\times\mathbf{p}-7.15\sqrt{\mathbf{n}\times\mathbf{p}}}{1-\mathbf{p}}\right)\right) + 4.$$

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **r(nr) – double array**

The reference vector.

2: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors detected by the function:

ifail $= 1$

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

ifail $= 2$

On entry, $\mathbf{p} < 0.0$,
or $\mathbf{p} > 1.0$.

ifail $= 3$

On entry, **nr** is too small (see Section 5).

7 Accuracy

Not applicable.

8 Further Comments

The time taken by g05ee increases with **nr**.

9 Example

```
n = int32(50);
p = 0.5;
nr = int32(250);
g05za('O');
g05cb(int32(0));
[r, ifail] = g05ee(n, p, nr)
```

```
r =
     array elided
ifail =
           0
```