

NAG Toolbox for MATLAB

g01bj

1 Purpose

g01bj returns the lower tail, upper tail and point probabilities associated with a Binomial distribution.

2 Syntax

```
[plek, pgtk, peqk, ifail] = g01bj(n, p, k)
```

3 Description

Let X denote a random variable having a Binomial distribution with parameters n and p ($n \geq 0$ and $0 < p < 1$). Then

$$\text{Prob}\{X = k\} = \binom{n}{k} p^k (1-p)^{n-k}, \quad k = 0, 1, \dots, n.$$

The mean of the distribution is np and the variance is $np(1-p)$.

g01bj computes for given n , p and k the probabilities:

$$\begin{aligned} \mathbf{plek} &= \text{Prob}\{X \leq k\} \\ \mathbf{pgtk} &= \text{Prob}\{X > k\} \\ \mathbf{peqk} &= \text{Prob}\{X = k\}. \end{aligned}$$

The method is similar to the method for the Poisson distribution described in Knüsel 1986.

4 References

Knüsel L 1986 Computation of the chi-square and Poisson distribution *SIAM J. Sci. Statist. Comput.* **7** 1022–1036

5 Parameters

5.1 Compulsory Input Parameters

1: **n – int32 scalar**

The parameter n of the Binomial distribution.

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

2: **p – double scalar**

The parameter p of the Binomial distribution.

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

3: **k – int32 scalar**

The integer k which defines the required probabilities.

Constraint: $0 \leq \mathbf{k} \leq \mathbf{n}$.

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **plek – double scalar**

The lower tail probability, $\text{Prob}\{X \leq k\}$.

2: **pgtk – double scalar**

The upper tail probability, $\text{Prob}\{X > k\}$.

3: **peqk – double scalar**

The point probability, $\text{Prob}\{X = k\}$.

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** < 0.

ifail = 2

On entry, **p** ≤ 0.0,
or **p** ≥ 1.0.

ifail = 3

On entry, **k** < 0,
or **k** > **n**.

ifail = 4

On entry, **n** is too large to be represented exactly as a double number.

ifail = 5

On entry, the variance ($= np(1 - p)$) exceeds 10^6 .

7 Accuracy

Results are correct to a relative accuracy of at least 10^{-6} on machines with a precision of 9 or more decimal digits, and to a relative accuracy of at least 10^{-3} on machines of lower precision (provided that the results do not underflow to zero).

8 Further Comments

The time taken by g01bj depends on the variance ($= np(1 - p)$) and on k . For given variance, the time is greatest when $k \approx np$ (= the mean), and is then approximately proportional to the square-root of the variance.

9 Example

```
n = int32(4);  
p = 0.5;  
k = int32(2);  
[plek, pgtk, peqk, ifail] = g01bj(n, p, k)
```

```
plek =  
    0.6875  
pgtk =  
    0.3125  
peqk =  
    0.3750  
ifail =  
        0
```
