NAG Toolbox for MATLAB

g01bk

1 Purpose

g01bk returns the lower tail, upper tail and point probabilities associated with a Poisson distribution.

2 Syntax

```
[plek, pgtk, peqk, ifail] = g01bk(rlamda, k)
```

3 Description

Let X denote a random variable having a Poisson distribution with parameter λ (> 0). Then

$$\text{Prob}\{X = k\} = e^{-\lambda}\frac{\lambda^k}{k!}, \qquad k = 0, 1, 2, \ldots$$

The mean and variance of the distribution are both equal to λ.

g01bk computes for given λ and k the probabilities:

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

The method is 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: **rlamda – double scalar**

The parameter λ of the Poisson distribution.

Constraint: $0.0 < \textbf{rlamda} \leq 10^6$.

2: **k – int32 scalar**

The integer k which defines the required probabilities.

Constraint: $\textbf{k} \geq 0$.

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, Prob$\{X \leq k\}$.

2: **pgtk – double scalar**

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

3: **peqk – double scalar**

The point probability, 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, **rlamda** ≤ 0.0.

ifail $= 2$

On entry, **k** < 0.

ifail $= 3$

On entry, **rlamda** $> 10^6$.

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 g01bk depends on λ and k. For given λ, the time is greatest when $k \approx \lambda$, and is then approximately proportional to $\sqrt{\lambda}$.

9 Example

```
rlamda = 0.75;
k = int32(3);
[plek, pgtk, peqk, ifail] = g01bk(rlamda, k)
```

```
plek =
    0.9927
pgtk =
    0.0073
peqk =
    0.0332
ifail =
           0
```