

NAG Toolbox for MATLAB

g05ex

1 Purpose

g05ex sets up the reference vector **r** for a discrete distribution with PDF (probability density function) or CDF (cumulative distribution function) **p**.

2 Syntax

```
[r, ifail] = g05ex(p, ip, lp, nr, 'np', np)
```

3 Description

g05ex sets up a reference vector **r** for use in g05ey according to information supplied by you in **p**. This may either be the PDF or CDF of the distribution. The reference vector contains the CDF of the distribution in its higher elements, preceded by an index of the form:

$r(1) =$ the number of elements of index, k

$r(2) =$ the value of **ip** – the (possibly nonpositive) subscript in **r** of the element of the CDF corresponding to **p**(1) [i.e., $r(2) \leq \mathbf{ip} - (k + 3)$].

$r(i + 2) = \min\{j \mid \text{CDF}(j) > (i - 1)/k\}$, for $i = 1, 2, \dots, k$

$r(i)$, for $i = k + 3, \dots, \mathbf{nr}$, the CDF.

4 References

Kendall M G and Stuart A 1969 *The Advanced Theory of Statistics (Volume 1)* (3rd Edition) Griffin

Knuth D E 1981 *The Art of Computer Programming (Volume 2)* (2nd Edition) Addison–Wesley

5 Parameters

5.1 Compulsory Input Parameters

1: **p(np)** – double array

The PDF or CDF of the distribution.

2: **ip** – int32 scalar

The value of the variate, assumed to be a whole number, to which the probability in **p**(1) corresponds.

3: **lp** – logical scalar

Indicates the type of information contained in **p**.

lp = true

p contains a cumulative distribution function (CDF).

lp = false

p contains a probability density function (PDF).

4: **nr – int32 scalar**

Suggested value: $\mathbf{nr} = 5 + 1.4 \times \mathbf{np}$ approximately (for optimum efficiency in g05ey).

Constraint: $\mathbf{nr} > \mathbf{np} + 2$.

5.2 Optional Input Parameters

1: **np – int32 scalar**

Default: The dimension of the array **p**.

Constraint: $\mathbf{np} > 0$.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **r(nr) – double array**

The reference vector **r** (see Section 3).

2: **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, $\mathbf{np} < 1$.

ifail = 2

On entry, $\mathbf{nr} \leq \mathbf{np} + 2$.

ifail = 3

If **lp** is **true** on entry, then the values in **p** are not all in non-descending order, as required by a CDF.
If **lp** is **false**, then at least one of the probabilities in **p** is negative, or all the probabilities are zero.

ifail = 4

The total probability is not 1. In this case, **r** is set up correctly since the error may be due to larger rounding errors than expected.

7 Accuracy

None.

8 Further Comments

None.

9 Example

```
p = [0;  
      0.1;  
      0.2;  
      0.4;  
      0.5;  
      0.6;  
      0.8;  
      0.9;  
      1;  
      1];  
ip = int32(0);  
lp = true;  
nr = int32(19);  
g05za('O');  
g05cb(int32(0));  
[r, ifail] = g05ex(p, ip, lp, nr)
```

```
r =  
  9.0000  
 -11.5000  
 12.5000  
 13.5000  
 14.5000  
 14.5000  
 15.5000  
 16.5000  
 17.5000  
 17.5000  
 18.5000  
  0.1000  
  0.2000  
  0.4000  
  0.5000  
  0.6000  
  0.8000  
  0.9000  
  1.0000  
ifail =  
      0
```