

NAG Toolbox for MATLAB

d01gz

1 Purpose

d01gz calculates the optimal coefficients, for use by d01gc and d01gd, when the number of points is the product of two primes.

2 Syntax

```
[vk, ifail] = d01gz(ndim, np1, np2)
```

3 Description

Korobov 1963 gives a procedure for calculating optimal coefficients for p -point integration over the n -cube $[0, 1]^n$, when the number of points is

$$p = p_1 p_2 \quad (1)$$

where p_1 and p_2 are distinct prime numbers.

The advantage of this procedure is that if p_1 is chosen to be the nearest prime integer to p_2^2 , then the number of elementary operations required to compute the rule is of the order of $p^{4/3}$ which grows less rapidly than the number of operations required by d01gy. The associated error is likely to be larger although it may be the only practical alternative for high values of p .

4 References

Korobov N M 1963 *Number Theoretic Methods in Approximate Analysis* Fizmatgiz, Moscow

5 Parameters

5.1 Compulsory Input Parameters

1: **ndim** – int32 scalar

n , the number of dimensions of the integral.

Constraint: **ndim** ≥ 1 .

2: **np1** – int32 scalar

The larger prime factor p_1 of the number of points in the integration rule.

Constraint: **np1** must be a prime number ≥ 5 .

3: **np2** – int32 scalar

The smaller prime factor p_2 of the number of points in the integration rule. For maximum efficiency, p_2^2 should be close to p_1 .

Constraint: **np2** must be a prime number such that **np1** $>$ **np2** ≥ 2 .

5.2 Optional Input Parameters

None.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

- 1: **vk(ndim)** – double array
The n optimal coefficients.
- 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, **ndim** < 1.

ifail = 2

On entry, **np1** < 5,
or **np2** < 2,
or **np1** ≤ **np2**.

ifail = 3

The value **np1** × **np2** exceeds the largest integer representable on the machine, and hence the optimal coefficients could not be used in a valid call of d01gc.

ifail = 4

On entry, **np1** is not a prime number.

ifail = 5

On entry, **np2** is not a prime number.

ifail = 6

The precision of the machine is insufficient to perform the computation exactly. Try smaller values of **np1** or **np2**, or use an implementation with higher precision.

7 Accuracy

The optimal coefficients are returned as exact integers (though stored in a double array).

8 Further Comments

The time taken by d01gz grows at least as fast as $(p_1 p_2)^{4/3}$. (See Section 3.)

9 Example

```
ndim = int32(4);
np1 = int32(89);
np2 = int32(11);
[vk, ifail] = d01gz(ndim, np1, np2)
```

```
vk =
     1
    102
    614
```

<pre> 951 ifail = 0</pre>
