

NAG Toolbox for MATLAB

c06db

1 Purpose

c06db returns the value of the sum of a Chebyshev-series through the function name.

2 Syntax

```
[result] = c06db(x, c, s, 'n', n)
```

3 Description

c06db evaluates the sum of a Chebyshev-series of one of three forms according to the value of the parameter **s**:

$$\begin{aligned} \mathbf{s} = 1 : & \quad 0.5c_1 + \sum_{j=2}^n c_j T_{j-1}(x), \\ \mathbf{s} = 2 : & \quad 0.5c_1 + \sum_{j=2}^n c_j T_{2j-2}(x), \\ \mathbf{s} = 3 : & \quad \sum_{j=1}^n c_j T_{2j-1}(x) \end{aligned}$$

where x lies in the range $-1.0 \leq x \leq 1.0$. Here $T_r(x)$ is the Chebyshev polynomial of order r in x , defined by $\cos(ry)$ where $\cos y = x$.

The method used is based upon a three-term recurrence relation; for details see Clenshaw 1962.

4 References

Clenshaw C W 1962 Mathematical tables *Chebyshev Series for Mathematical Functions* HMSO

5 Parameters

5.1 Compulsory Input Parameters

1: **x** – double scalar

The argument x of the series.

Constraint: $-1.0 \leq x \leq 1.0$.

2: **c(n)** – double array

c(j) must contain the coefficient c_j of the Chebyshev-series, for $j = 1, 2, \dots, n$.

3: **s** – int32 scalar

Must have the value 1, 2 or 3 according to whether the series is general, even or odd respectively (see Section 3). For all other values of **s**, the function behaves as though **s** = 2.

5.2 Optional Input Parameters

1: **n** – int32 scalar

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

n , the number of terms in the series.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **result – double scalar**

The result of the function.

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

On entry, **n** < 1,
or **x** < -1.0 or **x** > 1.0.

7 Accuracy

There may be a loss of significant figures due to cancellation between terms. However, provided that n is not too large, c06db yields results which differ little from the best attainable for a given word length.

8 Further Comments

The time taken increases with n .

c06db has been prepared in the present form to complement a number of integral equation solving functions which use Chebyshev-series methods, e.g., d05aa and d05ab.

9 Example

```
x = 0.5;  
c = [1;  
     1;  
     0.5;  
     0.25];  
s = int32(1);  
[result] = c06db(x, c, s)  
  
result =  
    0.5000
```