

# NAG Fortran Library Routine Document

## C06LCF

**Note:** before using this routine, please read the Users' Note for your implementation to check the interpretation of ***bold italicised*** terms and other implementation-dependent details.

### 1 Purpose

C06LCF evaluates an inverse Laplace transform at a given point, using the expansion coefficients computed by C06LBF.

### 2 Specification

```
SUBROUTINE C06LCF(T, SIGMA, B, M, ACOEF, ERRVEC, FINV, IFAIL)
  INTEGER          M, IFAIL
  real            T, SIGMA, B, ACOEF(M), ERRVEC(8), FINV
```

### 3 Description

This routine is designed to be used following a call to C06LBF, which computes an inverse Laplace transform by representing it as a Laguerre expansion of the form:

$$\tilde{f}(t) = e^{\sigma t} \sum_{i=0}^{m-1} a_i e^{-bt/2} L_i(bt), \quad \sigma > \sigma_O, \quad b > 0$$

where  $L_i(x)$  is the Laguerre polynomial of degree  $i$ .

This routine simply evaluates the above expansion for a specified value of  $t$ .

C06LCF is derived from the subroutine MODUL2 in Garbow *et al.* (1988b)

### 4 References

Garbow B S, Giunta G, Lyness J N and Murli A (1988b) Algorithm 662: A Fortran software package for the numerical inversion of the Laplace transform based on Weeks' method *ACM Trans. Math. Software* **14** 171–176

### 5 Parameters

- |    |  |               |
|----|--|---------------|
| 1: | $T$ – <b><i>real</i></b>   | <i>Input</i>  |
|    | <i>On entry:</i> the value $t$ for which the inverse Laplace transform $f(t)$ must be evaluated.               |               |
| 2: | $SIGMA$ – <b><i>real</i></b>   | <i>Input</i>  |
| 3: | $B$ – <b><i>real</i></b>   | <i>Input</i>  |
| 4: | $M$ – INTEGER  | <i>Input</i>  |
| 5: | $ACOE(M)$ – <b><i>real</i></b> array   | <i>Input</i>  |
| 6: | $ERRVEC(8)$ – <b><i>real</i></b> array   | <i>Input</i>  |
|    | <i>On entry:</i> $SIGMA$ , $B$ , $M$ , $ACOE$ and $ERRVEC$ must be unchanged from the previous call of C06LBF. |               |
| 7: | $FINV$ – <b><i>real</i></b>  | <i>Output</i> |
|    | <i>On exit:</i> the approximation to the inverse Laplace transform at $t$ .                                    |               |

## 8: IFAIL – INTEGER

*Input/Output*

*On entry:* IFAIL must be set to 0, -1 or 1. Users who are unfamiliar with this parameter should refer to Chapter P01 for details.

*On exit:* IFAIL = 0 unless the routine detects an error (see Section 6).

For environments where it might be inappropriate to halt program execution when an error is detected, the value -1 or 1 is recommended. If the output of error messages is undesirable, then the value 1 is recommended. Otherwise, because for this routine the values of the output parameters may be useful even if IFAIL  $\neq$  0 on exit, the recommended value is -1. **When the value -1 or 1 is used it is essential to test the value of IFAIL on exit.**

## 6 Error Indicators and Warnings

If on entry IFAIL = 0 or -1, explanatory error messages are output on the current error message unit (as defined by X04AAF).

Errors or warnings detected by the routine:

IFAIL = 1

The approximation to  $f(t)$  is too large to be representable: FINV is set to 0.0.

IFAIL = 2

The approximation to  $f(t)$  is too small to be representable: FINV is set to 0.0.

## 7 Accuracy

The error estimate returned by C06LBF in ERRVEC(1) has been found in practice to be a highly reliable bound on the pseudo-error  $|f(t) - \tilde{f}(t)|e^{-\sigma t}$ .

## 8 Further Comments

The routine is primarily designed to evaluate  $\tilde{f}(t)$  when  $t > 0$ . When  $t \leq 0$ , the result approximates the analytic continuation of  $f(t)$ ; the approximation becomes progressively poorer as  $t$  becomes more negative.

## 9 Example

See example for C06LBF.

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