C06LCF – NAG Fortran Library Routine Document

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 [1].

4 References

[1] Garbow B S, Giunta G, Lyness J N and Murli A (1988) 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 — ***real*** *Input*

On entry: the value t for which the inverse Laplace transform $f(t)$ must be evaluated.

2: SIGMA — ***real*** *Input*

3: B — ***real*** *Input*

4: M — INTEGER *Input*

5: ACOEF(M) — ***real*** array *Input*

6: ERRVEC(8) — ***real*** array *Input*

On entry: SIGMA, B, M, ACOEF and ERRVEC must be unchanged from the previous call of C06LBF.

7: FINV — ***real*** *Output*

On exit: 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 or gives a warning (see Section 6).

For this routine, because the values of output parameters may be useful even if IFAIL $\neq 0$ on exit, users are recommended to set IFAIL to −1 before entry. **It is then 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 specified 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.