NAG 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 (KIND=nag_wp) T, SIGMA, B, ACOEF(M), ERRVEC(8), FINV
```

3   Description

C06LCF 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.* (1988)

4   References

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 (KIND=nag_wp)   *Input*

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

2:    SIGMA – REAL (KIND=nag_wp)   *Input*
3:    B – REAL (KIND=nag_wp)   *Input*
4:    M – INTEGER   *Input*
5:    ACOEF(M) – REAL (KIND=nag_wp) array   *Input*
6:    ERRVEC(8) – REAL (KIND=nag_wp) array   *Input*

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

7:    FINV – REAL (KIND=nag_wp)   *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. If you are unfamiliar with this parameter you should refer to Section 3.3 in the Essential Introduction for details.

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, if you are not familiar with this parameter, the recommended value is 0. **When the value −1 or 1 is used it is essential to test the value of IFAIL on exit.**

On exit: IFAIL = 0 unless the routine detects an error or a warning has been flagged (see Section 6).

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.

IFAIL = −99

An unexpected error has been triggered by this routine. Please contact NAG.

See Section 3.8 in the Essential Introduction for further information.

IFAIL = −399

Your licence key may have expired or may not have been installed correctly.

See Section 3.7 in the Essential Introduction for further information.

IFAIL = −999

Dynamic memory allocation failed.

See Section 3.6 in the Essential Introduction for further information.

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 $\left|f(t) - \tilde{f}(t)\right|e^{-\sigma t}$.

8   Parallelism and Performance

Not applicable.

9   Further Comments

C06LCF 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.

10   Example

See example for C06LBF.