NAG Toolbox for MATLAB

c06lc

1 Purpose

c06lc evaluates an inverse Laplace transform at a given point, using the expansion coefficients computed by c06lb.

2 Syntax

```
[finv, ifail] = c06lc(t, sigma, b, acoef, errvec, 'm', m)
```

3 Description

c06lc is designed to be used following a call to c06lb, which computes an inverse Laplace transform by representing it as a Laguerre expansion of the form:

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

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

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

c06lc is derived from the (sub)program 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

5.1 Compulsory Input Parameters

1: **t – double scalar**

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

2: **sigma – double scalar**

3: **b – double scalar**

4: **acoef(m) – double array**

5: **errvec(8) – double array**

sigma, **b**, **m**, **acoef** and **errvec** must be unchanged from the previous call of c06lb.

5.2 Optional Input Parameters

1: **m – int32 scalar**

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

sigma, **b**, **m**, **acoef** and **errvec** must be unchanged from the previous call of c06lb.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **finv – double scalar**

The approximation to the inverse Laplace transform at t.

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 $= 1$

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 c06lb 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 Further Comments

c06lc 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

c06lb_f.m

```
function [f] = c06lb_f(s)
  f=3.0/(s^2-9.0);
  if isreal(f)
    f=complex(f);
  end
```

```
sigma0 = 3;
sigma = 0;
b = 0;
epstol = 1e-05;
[sigmaOut, bOut, m, acoef, errvec, ifail] = ...
    c06lb('c06lb_f', sigma0, sigma, b, epstol, 'mmax', int32(512));

fprintf('\nNo. of coefficients returned by c06lb = %d\n\n', m);
fprintf('                    Computed           Exact       Pseudo\n');
fprintf('        t               f(t)            f(t)        error\n');
for j = 0:5
  [finv, ifail] = c06lc(j, sigmaOut, bOut, acoef, errvec);
  exact = sinh(3*j);
  pserr = abs(finv-exact)/exp(sigmaOut*j);
  fprintf(' %10.2f %15.4f %15.4f %12.1g\n',j, finv, exact, pserr);
end
```

```
No. of coefficients returned by c06lb = 64
```

```
Computed           Exact       Pseudo
t              f(t)            f(t)        error
0.00          0.0000          0.0000        2e-09
       1.00         10.0179         10.0179        2e-09
       2.00        201.7132        201.7132        1e-10
       3.00       4051.5420       4051.5419        1e-09
       4.00      81377.3949      81377.3957        3e-10
       5.00    1634508.5023    1634508.6862        2e-09
```