

NAG Library Function Document

nag_bessel_k1_scaled (s18cdc)

1 Purpose

nag_bessel_k1_scaled (s18cdc) returns a value of the scaled modified Bessel function $e^x K_1(x)$.

2 Specification

```
#include <nag.h>
#include <nags.h>
double nag_bessel_k1_scaled (double x, NagError *fail)
```

3 Description

nag_bessel_k1_scaled (s18cdc) evaluates an approximation to $e^x K_1(x)$, where K_1 is a modified Bessel function of the second kind. The scaling factor e^x removes most of the variation in $K_1(x)$.

The function uses the same Chebyshev expansions as nag_bessel_k1 (s18adc), which returns the unscaled value of $K_1(x)$.

4 References

Abramowitz M and Stegun I A (1972) *Handbook of Mathematical Functions* (3rd Edition) Dover Publications

5 Arguments

- 1: **x** – double *Input*
On entry: the argument x of the function.
Constraint: $x > 0.0$.
- 2: **fail** – NagError * *Input/Output*
 The NAG error argument (see Section 3.6 in the Essential Introduction).

6 Error Indicators and Warnings

NE_ALLOC_FAIL

Dynamic memory allocation failed.
 See Section 3.2.1.2 in the Essential Introduction for further information.

NE_INTERNAL_ERROR

An internal error has occurred in this function. Check the function call and any array sizes. If the call is correct then please contact NAG for assistance.

An unexpected error has been triggered by this function. Please contact NAG.
 See Section 3.6.6 in the Essential Introduction for further information.

NE_NO_LICENCE

Your licence key may have expired or may not have been installed correctly.
 See Section 3.6.5 in the Essential Introduction for further information.

NE_REAL_ARG_LE

On entry, $x = \langle value \rangle$.
 Constraint: $x > 0.0$.
 K_1 is undefined and the function returns zero.

NE_REAL_ARG_TOO_SMALL

On entry, $x = \langle value \rangle$.
 Constraint: $x > \langle value \rangle$.
 The function returns the value of the function at the smallest permitted value of the argument.

7 Accuracy

Relative errors in the argument are attenuated when propagated into the function value. When the accuracy of the argument is essentially limited by the *machine precision*, the accuracy of the function value will be similarly limited by at most a small multiple of the *machine precision*.

8 Parallelism and Performance

Not applicable.

9 Further Comments

None.

10 Example

This example reads values of the argument x from a file, evaluates the function at each value of x and prints the results.

10.1 Program Text

```

/* nag_bessel_k1_scaled (s18cdc) Example Program.
 *
 * Copyright 2014 Numerical Algorithms Group.
 *
 * Mark 2 revised, 1992.
 */

#include <nag.h>
#include <stdio.h>
#include <nag_stdlib.h>
#include <nags.h>

int main(void)
{
  Integer  exit_status = 0;
  double   x, y;
  NagError fail;

  INIT_FAIL(fail);

  /* Skip heading in data file */
#ifdef _WIN32
  scanf_s("%*[\n]");
#else
  scanf("%*[\n]");
#endif
  printf("nag_bessel_k1_scaled (s18cdc) Example Program Results\n");
  printf("      x              y\n");
#ifdef _WIN32
  while (scanf_s("%lf", &x) != EOF)
#else
  while (scanf("%lf", &x) != EOF)
#endif

```

```
while (scanf("%lf", &x) != EOF)
#endif
{
    /* nag_bessel_k1_scaled (s18cdc).
     * Scaled modified Bessel function exp(x) K_1(x)
     */
    y = nag_bessel_k1_scaled(x, &fail);
    if (fail.code != NE_NOERROR)
    {
        printf("Error from nag_bessel_k1_scaled (s18cdc).\n%s\n",
              fail.message);
        exit_status = 1;
        goto END;
    }
    printf("%12.3e%12.3e\n", x, y);
}

END:
return exit_status;
}
```

10.2 Program Data

nag_bessel_k1_scaled (s18cdc) Example Program Data

0.4
0.6
1.4
2.5
10.0
1000.0

10.3 Program Results

nag_bessel_k1_scaled (s18cdc) Example Program Results

x	y
4.000e-01	3.259e+00
6.000e-01	2.374e+00
1.400e+00	1.301e+00
2.500e+00	9.002e-01
1.000e+01	4.108e-01
1.000e+03	3.965e-02
