

# NAG Library Function Document

## nag\_bessel\_k0\_scaled (s18ccc)

### 1 Purpose

nag\_bessel\_k0\_scaled (s18ccc) returns a value of the scaled modified Bessel function  $e^x K_0(x)$ .

### 2 Specification

```
#include <nag.h>
#include <nags.h>
double nag_bessel_k0_scaled (double x, NagError *fail)
```

### 3 Description

nag\_bessel\_k0\_scaled (s18ccc) evaluates an approximation to  $e^x K_0(x)$ , where  $K_0$  is a modified Bessel function of the second kind. The scaling factor  $e^x$  removes most of the variation in  $K_0(x)$ .

The function uses the same Chebyshev expansions as nag\_bessel\_k0 (s18acc), which returns the unscaled value of  $K_0(x)$ .

### 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,  $x = \langle \text{value} \rangle$ .  
 Constraint:  $x > 0.0$ .

**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_k0_scaled (s18ccc) 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_k0_scaled (s18ccc) Example Program Results\n");
  printf("      x              y\n");
#ifdef _WIN32
  while (scanf_s("%lf", &x) != EOF)
#else
  while (scanf("%lf", &x) != EOF)
#endif
  {
    /* nag_bessel_k0_scaled (s18ccc).
     * Scaled modified Bessel function exp(x) K_0(x)
     */
    y = nag_bessel_k0_scaled(x, &fail);
    if (fail.code != NE_NOERROR)

```

```
    {
      printf("Error from nag_bessel_k0_scaled (s18ccc).\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_k0_scaled (s18ccc) Example Program Data
      0.4
      0.6
      1.4
      2.5
     10.0
    1000.0
```

## 10.3 Program Results

```
nag_bessel_k0_scaled (s18ccc) Example Program Results
      x           y
  4.000e-01   1.663e+00
  6.000e-01   1.417e+00
  1.400e+00   9.881e-01
  2.500e+00   7.595e-01
  1.000e+01   3.916e-01
  1.000e+03   3.963e-02
```

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