

NAG C Library Function Document

nag_bessel_k_nu (s18efc)

1 Purpose

nag_bessel_k_nu (s18efc) returns the value of the modified Bessel function $K_{\nu/4}(x)$ for real $x > 0$.

2 Specification

```
double nag_bessel_k_nu (double x, Integer nu, NagError *fail)
```

3 Description

This routine evaluates an approximation to the modified Bessel function of the second kind $K_{\nu/4}(x)$, where the order $\nu = -3, -2, -1, 1, 2$ or 3 and x is real and positive. For negative orders the formula

$$K_{-\nu/4}(x) = K_{\nu/4}(x)$$

is used.

4 Parameters

- | | | |
|----|--|---------------------|
| 1: | x – double | <i>Input</i> |
| | <i>On entry:</i> the argument x of the function. | |
| | <i>Constraint:</i> $x > 0.0$. | |
| 2: | nu – Integer | <i>Input</i> |
| | <i>On entry:</i> the argument ν of the function. | |
| | <i>Constraint:</i> $1 \leq \text{abs}(\mathbf{nu}) \leq 3$. | |
| 3: | fail – NagError * | <i>Input/Output</i> |
| | The NAG error parameter (see the Essential Introduction). | |

5 Error Indicators and Warnings

NE_REAL

On entry, **x** = *<value>*.
 Constraint: $x > 0.0$.

NE_INT

On entry, **nu** = *<value>*.
 Constraint: $1 \leq \text{abs}(\mathbf{nu}) \leq 3$.

NE_OVERFLOW_LIKELY

The evaluation has been abandoned due to the likelihood of overflow. The result is returned as zero.

NW_SOME_PRECISION_LOSS

The evaluation has been completed but some precision has been lost.

NE_TOTAL_PRECISION_LOSS

The evaluation has been abandoned due to total loss of precision. The result is returned as zero.

NE_TERMINATION_FAILURE

The evaluation has been abandoned due to failure to satisfy the termination condition. The result is returned as zero.

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 consult NAG for assistance.

6 Further Comments**6.1 Accuracy**

All constants in the underlying function are specified to approximately 18 digits of precision. If t denotes the number of digits of precision in the floating-point arithmetic being used, then clearly the maximum number of correct digits in the results obtained is limited by $p = \min(t, 18)$. Because of errors in argument reduction when computing elementary functions inside the underlying function, the actual number of correct digits is limited, in general, by $p - s$, where $s \approx \max(1, |\log_{10} x|)$ represents the number of digits lost due to the argument reduction. Thus the larger the value of x , the less the precision in the result.

6.2 References

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

7 See Also

None.

8 Example

The example program reads values of the arguments x and ν from a file, evaluates the function and prints the results.

8.1 Program Text

```
/* nag_bessel_k_nu (s18efc) Example Program.
 *
 * Copyright 2000 Numerical Algorithms Group.
 *
 * NAG C Library
 *
 * Mark 6, 2000.
 */

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

int main(void)
{
    double x;
    double y;
```

```

Integer exit_status=0;
Integer nu;
NagError fail;

INIT_FAIL(fail);
Vprintf("s18efc Example Program Results\n\n");
/* Skip heading in data file */
Vscanf("%*[^\\n]");
Vprintf("\n  x          nu          y\n\n");
while (scanf("%lf %ld%*[^\\n]", &x, &nu) != EOF)
{
  y = s18efc (x, nu, &fail);
  if (fail.code == NE_NOERROR)
    Vprintf("%4.1f %6ld %12.4e\n", x, nu, y);
  else
  {
    Vprintf("Error from s18efc.\n%s\n", fail.message);
    exit_status = 1;
    goto END;
  }
}
END:
return exit_status;
}

```

8.2 Program Data

s18efc Example Program Data

3.9	-3
1.4	-2
8.2	-1
6.7	1
0.5	2
2.3	3

: Values of x and nu

8.3 Program Results

s18efc Example Program Results

x	nu	y
3.9	-3	1.3315e-02
1.4	-2	2.6121e-01
8.2	-1	1.1892e-04
6.7	1	5.8826e-04
0.5	2	1.0750e+00
2.3	3	8.7724e-02
