Chapter 3
Special Functions

1 Scope of the Chapter

This chapter is concerned with the approximation of some commonly occurring physical and mathematical functions.

2 Available Modules

Module 3.1: `nag_inv_hyp_fun` — **Inverse hyperbolic functions**

This module contains procedures for approximating:

- the inverse hyperbolic functions $\operatorname{arctanh} x$, $\operatorname{arcsinh} x$ and $\operatorname{arccosh} x$.

Module 3.2: `nag_gamma_fun` — **Gamma functions**

This module contains procedures for approximating:

- the gamma function $\Gamma(x)$;
- the log gamma function $\ln \Gamma(x)$;
- scaled derivatives of the psi function;
- the incomplete gamma functions $P(a, x)$ and $Q(a, x)$.

Module 3.3: `nag_err_fun` — **Error functions**

This module contains procedures for approximating:

- the error function $\operatorname{erf} x$;
- the complementary error function $\operatorname{erfc} x$;
- Dawson's integral.

Module 3.4: `nag_bessel_fun` — **Bessel functions**

This module contains procedures for approximating:

- the Bessel functions $J_0(x)$, $J_1(x)$, $Y_0(x)$ and $Y_1(x)$, for real x;
- the modified Bessel functions $I_0(x)$, $I_1(x)$, $K_0(x)$ and $K_1(x)$, for real x;
- the Bessel functions $J_\nu(z)$ and $Y_\nu(z)$, for complex z;
- the modified Bessel functions $I_\nu(z)$ and $K_\nu(z)$, for complex z.

Module 3.5: `nag_fresnel_intg` — **Fresnel integrals**

This module contains procedures for approximating:

- the Fresnel integrals $S(x)$ and $C(x)$.

Module 3.6: `nag_ell_intg` — **Elliptic integrals**

This module contains procedures for approximating:

- the symmetrised elliptic integrals of the 1st, 2nd and the 3rd kind;
- the degenerate symmetrised elliptic integrals of the 1st kind.

Module 3.7: `nag_ell_fun` — **Elliptic functions**

This module contains a procedure for approximating:

- the Jacobian elliptic functions sn, cn and dn.

Module 3.8: `nag_airy_fun` — **Airy functions**

This module contains procedures for approximating:

- the Airy function $Ai(z)$ or its derivative $Ai'(z)$, for real/complex z;
- the Airy function $Bi(z)$ or its derivative $Bi'(z)$, for real/complex z.

Module 3.9: `nag_kelvin_fun` — **Kelvin functions**

This module contains procedures for approximating:

- the Kelvin functions ber x, bei x, ker x and kei x.