Functions in Mathematica (A Selection)

2015-03-12

Numerical Functions **(§ 13.2)**

Floor[x] Ceiling [x] Round[x] Chop[x] Max[] Min[] N[]

Complex Numbers **(§ 13.3)**

Re[] Im[] Abs[] Arg[] Conjugate[]

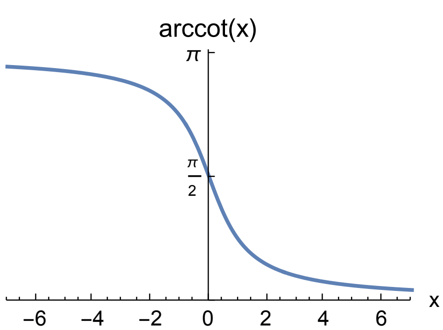
Random Numbers **(§ 13.4)**

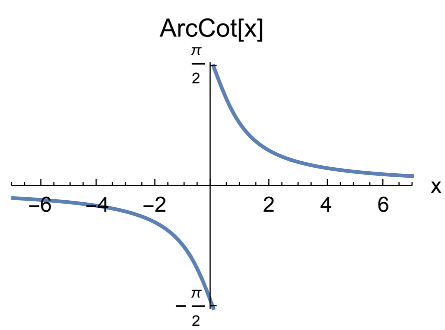
Random[]

functionTrigonometric Functions and Inverses **(§ 13.9)**

Sin[z]	ArcSin[z]	Cot[z] = 1/Tan[z]	ArcCot[z]
Cos[z]	ArcCos[z]	Csc[z] = 1/Sin[z]	ArcCsc[z]
Tan[z]	ArcTan[z]	Sec[z] = 1/Cos[z]	ArcSec[z]

The range of values of the function program ArcCot[z] disagreßes with the ususal definition of the principal branch of the multi-valued function arccot[x], s. Fig.





Exponentials, Logarithms **(§ 13.8)**

Exp[z] Log[z] (Basis e) Log[b,z] (Basis b), e.g. Log[10,z]

Hyperbolic Functions and Inverses (§ 13.10)

Cosh[z] ArcCosh[z] = Log[z + √(z^2 – 1)]
Sinh[z] ArcSinh[z] = Log[z + √(z^2 + 1)]
Tanh[z] ArcTanh[z] = Log[(1+ z)(1 - z)]/2
Coth[z] = 1/Tanh[z] ArcCoth[z] = Log[(z + 1)(z - 1)]/2
Csch[z] = 1/Sinh[z] ArcCsch[z] = Log[1/z + √(1/z^2 + 1)]
Sech[z] = 1/Cosh[z] ArcSech[z] = Log[1/z + √(1/z^2 - 1)]

Factorials, Binomial Coefficients and Vector Coupling Coefficients (§ 13.5)

z! = Gamma[z + 1]
n!! = n (n – 2)() ... 2 or 1
Binomial[z,k] = z!/[k! (n - k)!]

ClebschGordan[{j1,m1},{j2,m2},{j3,m3}]
ThreeJSymbol[{j1,m1},{j2,m2},{j3,m3}]
SixJSymbol[{j1,j2,j3},{j4,j5,j6}]

Error Functions

$$\mathrm{erf}(z) = \frac{2}{\sqrt{\pi}} \int_0^z e^{-t^2}\, dt \quad , \quad \texttt{Erfc}[z] = \mathrm{erfc}(z) = 1 - \mathrm{erf}(z).$$

Spherical Harmonics and Legendre Polynomials

LegendreP[n,z] = $P_n(z)$ LegendreP[n,m,z] = $P_n^m(z)$

LegendreQ[n,z] = $Q_n(z)$ LegendreQ[n,m,z] = $P_n^m(z)$

SphericalHarmonicY[m,n,theta,phi] = Ynm(ϑ,φ)

Legendre Functions
Solutions of Legendres differential equation for values oft he parameters leading to transcendental functions. Special cases are Toroidal functions and Conical functions.

Hermite and Laguerre Polynomials

HermiteH[n,z] = $H_n(z)$ LaguerreL[n,z] = $L_n[z]$

LaguerreL[n,α,z] = $L_n^\alpha[z]$

Cylindrical functions = Besselfunctions

BesselJ[ν,z] = $J_\nu(z)$ BesselY[ν,z] = $Y_\nu(z)$

BesselI[ν,z] = $I_\nu(z)$ BesselK[ν,z] = $K_\nu(z)$

Mathieu functions
Elliptic Cylinder functions. Some of the functions programmes do not give correct values for some values of the parameters.

Spheroidal functions
Solutions for the Helmholtz equation in rotational elliptic coordinates

Hypergeometric functions **(§ 7.2.2)**

Almost all functions are defined as given in the books listed below.
Note that Log, inverse trigonometric and inverse hyperbolic functions are multiple-valued. The programs give the principal value. This requires special care, in particular, in using results of analytical integrations.

There is one important **exception:** *Mathematica* defines **the principal value** of **arccot[x]** in a way differnt from the usual one.

In most cases, *Mathematica* uses the functions as defined in

Books on Functions:
M. Abramowitz and I. Stegun:
Handbook of Mathematical Functions, Verlag Dover, 1974
Poceketbook of Mathematical Functions, Verlag Deutsch, 1984

F.W.J. Olver, D.W. Lozier, R.F. Boisvert, Ch.W. Clark:
NIST Handbook of Mathematical Functions
Cambridge University Press, 2010

List of functions and their properties:
An extensive list of properties of many functions is at:
http://functions.wolfram.com