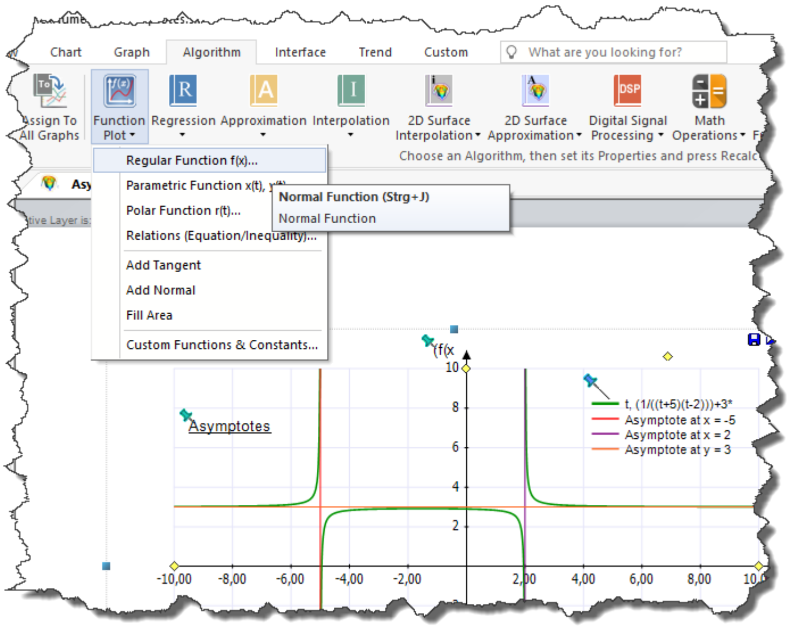
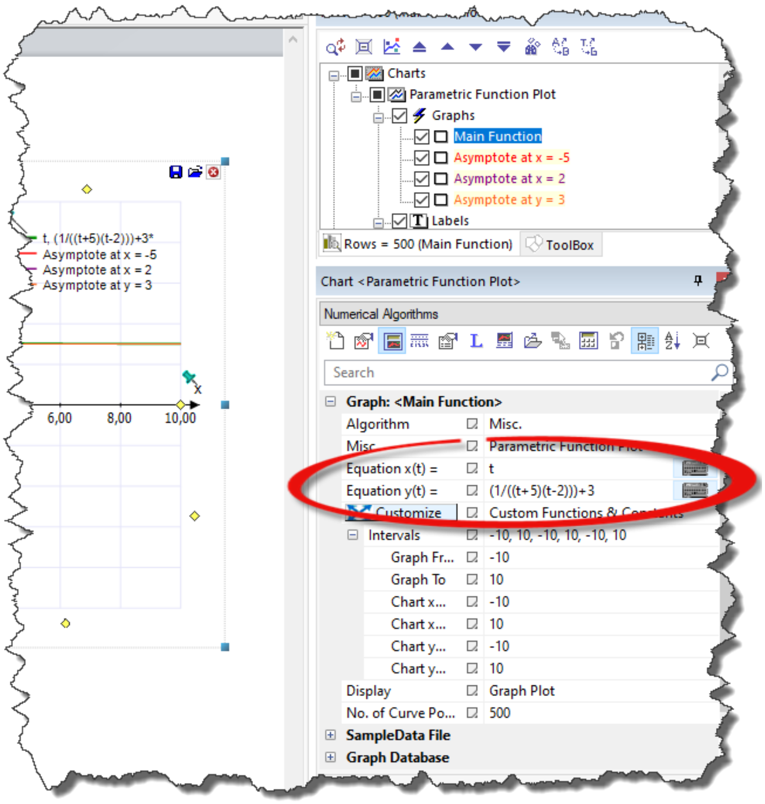
Info zu *SimplexNumerica* V17

List of Formula Parser Functions

Explicitly entered formulas are required at various points in the program. Here is the best-known example: The function plot. Available in the algorithm ribbon bar, icon Function plot.

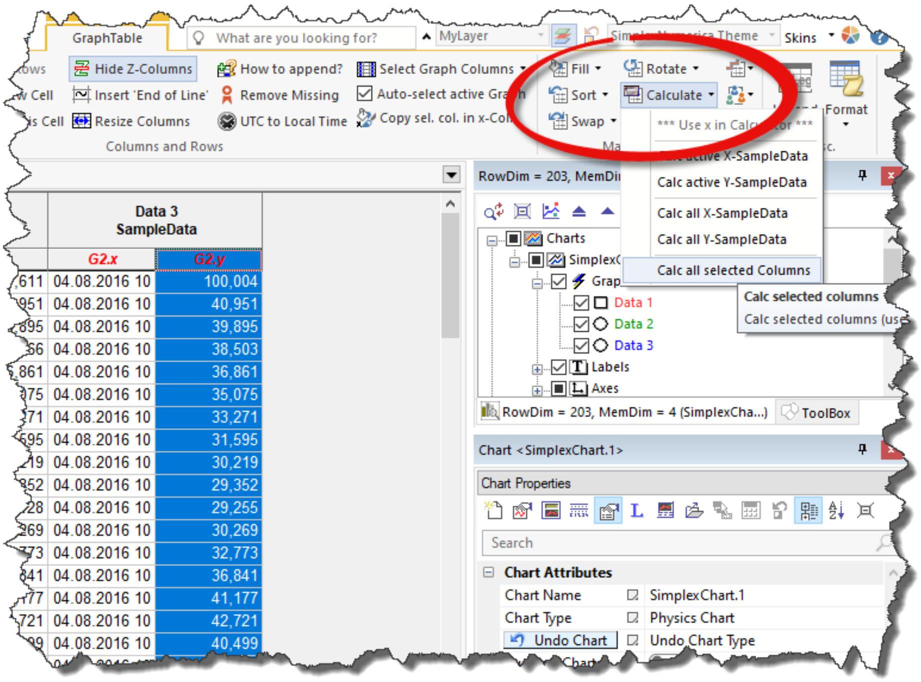


The formula can be entered directly via the properties or by means of *Simplexety*.

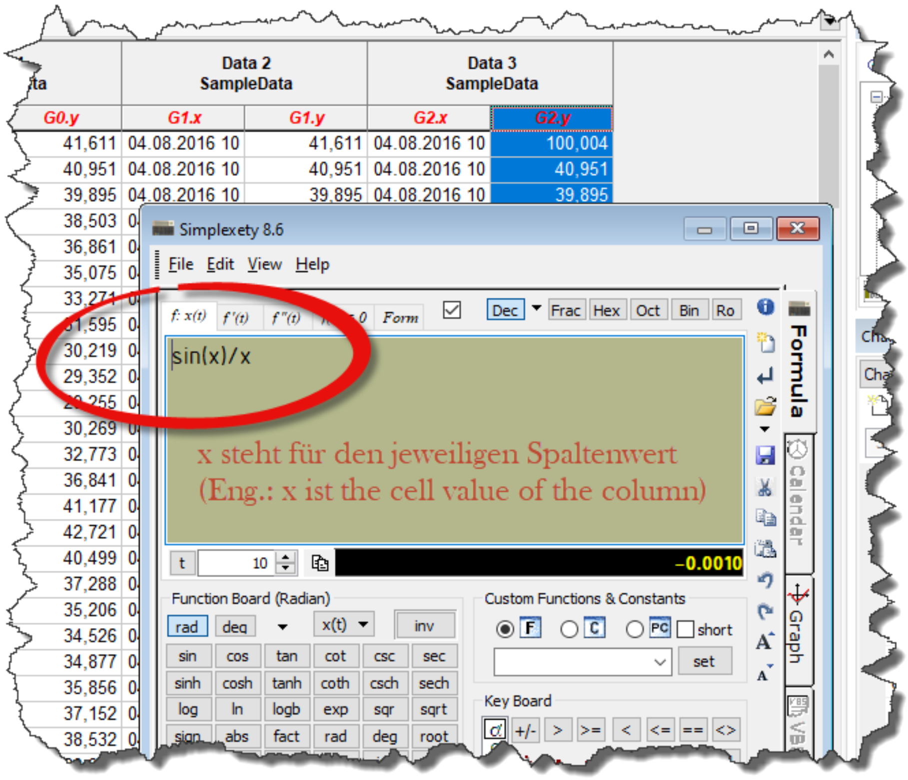


Another place where you need a formula is the GraphTable.

Label Format



Here, for example, you want to correct the data of certain columns with a formula.



Press the Button  to quit the dialog.

Label Format

Here is a list of Formula Parser Functions adapted from the famous program Graph by Ivan Johansen (SimplexNumerica's author Ralf Wirtz got a special license from Mr. Johansen).

The following is a list of all variables, constants, operators and functions supported by the program. The list of operators shows the operators with the highest precedence first. The precedence of operators can be changed through the use of brackets. (), {} and [] may all be used alike. Notice that expressions in *SimplexNumerica* are case insensitive, i.e. there are no difference between upper- and lower-case characters. The only exception is e as Euler's constant and E as the exponent in a number in scientific notation.

The following table shows all inbuilt **Constants**:

Constant	Description
x	The independent variable used in standard functions.
t	The independent variable called parameter for parametric functions and polar angle for polar functions.
e	Euler's constant. In this program defined as e=2.718281828459045235360287
pi	The constant p, which in this program is defined as pi=3.141592653589793238462643
undef	Always returns an error. Used to indicate that part of a function is undefined.
i	The imaginary unit. Defined as i2 = -1. Only useful when working with complex numbers.
inf	The constant for infinity. Only useful as argument to the integrate function.
rand	Evaluates to a random number between 0 and 1.

The next table shows all inbuilt **Operator**:

Operator	
Exponentiation (^)	Raise to the power of an exponent. Example: f(x)=2^x
Negation (-)	The negative value of a factor. Example: f(x)=-x
Logical NOT (not)	not a evaluates to 1 if a is zero, and evaluates to 0 otherwise.
Multiplication (*)	Multiplies two factors. Example: f(x)=2*x
Division (/)	Divides two factors. Example: f(x)=2/x
Addition (+)	Adds two terms. Example: f(x)=2+x
Subtraction (-)	Subtracts two terms. Example: f(x)=2-x

Greater than (>)	Indicates if an expression is greater than another expression.
Greater than or equal to (>=)	Indicates if an expression is greater or equal to another expression.
Less than (<)	Indicates if an expression is less than another expression.
Less than or equal to (<=)	Indicates if an expression is less or equal to another expression.
Equal (=)	Indicates if two expressions evaluate to the exact same value.
Not equal (<>)	Indicates if two expressions does not evaluate to the exact same value.
Logical AND (and)	a and b evaluates to 1 if both a and b are non-zero, and evaluates to 0 otherwise.
Logical OR (or)	a or b evaluates to 1 if either a or b are non-zero, and evaluates to 0 otherwise.
Logical XOR (xor)	a xor b evaluates to 1 if either a or b, but not both, are non-zero, and evaluates to 0 otherwise.

The next table shows all inbuilt **Functions**:

Function	Description
	Trigometric
sin	Returns the sine of the argument, which may be in radians or degrees.
cos	Returns the cosine of the argument, which may be in radians or degrees.
tan	Returns the tangent of the argument, which may be in radians or degrees.
asin	Returns the inverse sine of the argument. The returned value may be in radians or degrees.
acos	Returns the inverse cosine of the argument. The returned value may be in radians or degrees.
atan	Returns the inverse tangent of the argument. The returned value may be in radians or degrees.
sec	Returns the secant of the argument, which may be in radians or degrees.
csc	Returns the cosecant of the argument, which may be in radians or degrees.
cot	Returns the cotangent of the argument, which may be in radians or degrees.
asec	Returns the inverse secant of the argument. The returned value may be in radians or degrees.
acsc	Returns the inverse cosecant of the argument. The returned value may be in radians or degrees.
acot	Returns the inverse cotangent of the argument. The returned value may be in radians or degrees.

Label Format

	Hyperbolic
sinh	Returns the hyperbolic sine of the argument.
cosh	Returns the hyperbolic cosine of the argument.
tanh	Returns the hyperbolic tangent of the argument.
asinh	Returns the inverse hyperbolic sine of the argument.
acosh	Returns the inverse hyperbolic cosine of the argument.
atanh	Returns the inverse hyperbolic tangent of the argument.
csch	Returns the hyperbolic cosecant of the argument.
sech	Returns the hyperbolic secant of the argument.
coth	Returns the hyperbolic cotangent of the argument.
acsch	Returns the inverse hyperbolic cosecant of the argument.
asech	Returns the inverse hyperbolic secant of the argument.
acoth	Returns the inverse hyperbolic cotangent of the argument.
	Power and Logarithm
sqr	Returns the square of the argument, i.e. the power of two.
exp	Returns e raised to the power of the argument.
sqrt	Returns the square root of the argument.
root	Returns the nth root of the argument.
ln	Returns the logarithm with base e to the argument.
log	Returns the logarithm with base 10 to the argument.
logb	Returns the logarithm with base n to the argument.
	Complex
abs	Returns the absolute value of the argument.
arg	Returns the angle of the argument in radians or degrees.
conj	Returns the conjugate of the argument.
re	Returns the real part of the argument.

Label Format

im	Returns the imaginary part of the argument.
	Rounding
trunc	Returns the integer part of the argument.
fract	Returns the fractional part of the argument.
ceil	Rounds the argument up to nearest integer.
floor	Rounds the argument down to the nearest integer.
round	Rounds the first argument to the number of decimals given by the second argument.
	Piecewise
sign	Returns the sign of the argument: 1 if the argument is greater than 0, and -1 if the argument is less than 0.
u	Unit step: Returns 1 if the argument is greater than or equal 0, and 0 otherwise.
min	Returns the smallest of the arguments.
max	Returns the greatest of the arguments.
range	Returns the second argument if it is in the range of the first and third argument.
if	Returns the second argument if the first argument does not evaluate to 0; Else the third argument is returned.
	Special
integrate	Returns the numeric integral of the first argument from the second argument to the third argument.
sum	Returns the sum of the first argument evaluated for each integer in the range from the second to the third argument.
product	Returns the product of the first argument evaluated for each integer in the range from the second to the third argument.
fact	Returns the factorial of the argument.
gamma	Returns the Euler gamma function of the argument.
beta	Returns the beta function evaluated for the arguments.
W	Returns the Lambert W-function evaluated for the argument.

zeta	Returns the Riemann Zeta function evaluated for the argument.
mod	Returns the remainder of the first argument divided by the second argument.
dnorm	Returns the normal distribution of the first argument with optional mean value and standard deviation.

Notice the following relations:

sin(x)^2 = (sin(x))^2
sin 2x = sin(2x)
sin 2+x = sin(2)+x
sin x^2 = sin(x^2)
2(x+3)x = 2*(x+3)*x
-x^2 = -(x^2)
2x = 2*x
e^2x = e^(2*x)
x^2^3 = x^(2^3)

Constants

rand constant

Returns a random number in the range 0 to 1.

Syntax
rand

Description
rand is used as a constant but returns a new pseudo-random number each time it is evaluated. The value is a
real number in the range [0;1].

Remarks
Because rand returns a new value each time it is evaluated, a graph using rand will not look the same each time it is drawn. A graph using rand will also change when the program is forced to redraw, e.g. because the
coordinate system is moved, resized or zoomed.

Implementation
rand uses a multiplicative congruential random number generator with period 2 to the 32nd power to return
successive pseudo-random numbers in the range from 0 to 1.

See also
Wikipedia [http://en.wikipedia.org/wiki/Random_number_generator#Computational_methods]

Trigonometric

sin function

Returns the sine of the argument.

Syntax
sin(z)

Description
The sin function calculates the sine of an angle z, which may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number or a complex number. If z is a real number, the result will be in the range -1 to 1.

Remarks
For arguments with a large magnitude, the function will begin to lose precision.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Sine]

---

cos function

Returns the cosine of the argument.

Syntax
cos(z)

Description
The cos function calculates the cosine of an angle z, which may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number or a complex number. If z is a real number, the result will be in the range -1 to 1.

Remarks
For arguments with a large magnitude, the function will begin to lose precision.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Cosine]

---

tan function

Returns the tangent of the argument.

Syntax
tan(z)

Description
The tan function calculates the tangent of an angle z, which may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number or a complex number.

Remarks
For arguments with a large magnitude, the function will begin to lose precision. tan is undefined at z = p*p/2, where p is an integer, but the function returns a very large number if z is near the undefined value.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Tangent]

---

asin function

Returns the inverse sine of the argument.

Syntax
asin(z)

Description
The asin function calculates the inverse sine of z. The result may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number. This is the reverse of the sin function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

---

acos function

Returns the inverse cosine of the argument.

Syntax
acos(z)

Description
The acos function calculates the inverse cosine of z. The result may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number. This is the reverse of the cos function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

---

atan function
Returns the inverse tangent of the argument.

Syntax
atan(z)

Description
The atan function calculates the inverse tangent of z. The result may be in radians or degrees depending on the current settings. z may be any numeric expression that evaluates to a real number. This is the reverse of the tan function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

---

sec function
Returns the secant of the argument.

Syntax
sec(z)

Description
The sec function calculates the secant of an angle z, which may be in radians or degrees depending on the current settings. sec(z) is the same as 1/cos(z). z may be any numeric expression that evaluates to a real number or a complex number.

Remarks
For arguments with a large magnitude, the function will begin to lose precision.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Reciprocal_functions]

---

csc function
Returns the cosecant of the argument.

Syntax
csc(z)

Description
The csc function calculates the cosecant of an angle z, which may be in radians or degrees depending on

the current settings. csc(z) is the same as 1/sin(z). z may be any numeric expression that evaluates to a real number or a complex number.

Remarks
For arguments with a large magnitude, the function will begin to lose precision.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Reciprocal_functions]

---

ot function

Returns the cotangent of the argument.

Syntax
cot(z)

Description
The cot function calculates the cotangent of an angle z, which may be in radians or degrees depending on the current settings. cot(z) is the same as 1/tan(z). z may be any numeric expression that evaluates to a real number or a complex number.

Remarks
For arguments with a large magnitude, the function will begin to lose precision.

See also
Wikipedia [http://en.wikipedia.org/wiki/Trigonometric_functions#Reciprocal_functions]

---

asec function

Returns the inverse secant of the argument.

Syntax
asec(z)

Description
The asec function calculates the inverse secant of z. The result may be in radians or degrees depending on the current settings. asec(z) is the same as acos(1/z). z may be any numeric expression that evaluates to a real
number. This is the reverse of the sec function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

---

acsc function
Returns the inverse cosecant of the argument.

Syntax
acsc(z)

Description
The acsc function calculates the inverse cosecant of z. The result may be in radians or degrees depending on the current settings. acsc(z) is the same as asin(1/z). z may be any numeric expression that evaluates to a real number. This is the reverse of the csc function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

---

acot function
Returns the inverse cotangent of the argument.

Syntax
acot(z)

Description
The acot function calculates the inverse cotangent of z. The result may be in radians or degrees depending on the current settings. acot(z) is the same as atan(1/z). z may be any numeric expression that evaluates to a real number. This is the reverse of the cot function.

Remarks
The acot function returns a value in the range]-p/2;p/2] (]-90;90] when calculating in degrees), which is the most common definition, though some may define it to be in the range]0;p[.

See also
Wikipedia [http://en.wikipedia.org/wiki/Inverse_trigonometric_functions]

Hyperbolic

sinh function
Returns the hyperbolic sine of the argument.

Syntax
sinh(z)

Description
The sinh function calculates the hyperbolic sine of z. z may be any numeric expression that evaluates to a

real number or a complex number.
Hyperbolic sine is defined as: sinh(z) = ½(ez-e-z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

cosh function

Returns the hyperbolic cosine of the argument.

Syntax
cosh(z)

Description
The cosh function calculates the hyperbolic cosine of z. z may be any numeric expression that evaluates to a real number or a complex number.
Hyperbolic cosine is defined as: cosh(z) = ½(ez+e-z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

tanh function

Returns the hyperbolic tangent of the argument.

Syntax
tanh(z)

Description
The tanh function calculates the hyperbolic tangent of z. z may be any numeric expression that evaluates to a real number or a complex number.
Hyperbolic tangent is defined as: tanh(z) = sinh(z)/cosh(z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

asinh function

Returns the inverse hyperbolic sine of the argument.

Syntax
asinh(z)

Description
The asinh function calculates the inverse hyperbolic sine of z. z may be any numeric expression that

evaluates to a real number or a complex number. asinh is the reverse of sinh, i.e. asinh(sinh(z)) = z.

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

acosh function

Returns the inverse hyperbolic cosine of the argument.

Syntax
acosh(z)

Description
The acosh function calculates the inverse hyperbolic cosine of z. z may be any numeric expression that evaluates to a real number or a complex number. acosh is the reverse of cosh, i.e. acosh(cosh(z)) = z.

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

atanh function

Returns the inverse hyperbolic tangent of the argument.

Syntax
atanh(z)

Description
The atanh function calculates the inverse hyperbolic tangent of z. z may be any numeric expression that evaluates to a real number or a complex number. atanh is the reverse of tanh, i.e. atanh(tanh(z)) = z.

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

csch function

Returns the hyperbolic cosecant of the argument.

Syntax
csch(z)

Description
The csch function calculates the hyperbolic cosecant of z. z may be any numeric expression that evaluates to a real number or a complex number.
Hyperbolic cosecant is defined as: csch(z) = 1/sinh(z) = 2/(ez-e-z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

sech function

Returns the hyperbolic secant of the argument.

Syntax
sech(z)

Description
The sech function calculates the hyperbolic secant of z. z may be any numeric expression that evaluates to a real number or a complex number.
Hyperbolic secant is defined as: sech(z) = 1/cosh(z) = 2/(ez+e-z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

coth function

Returns the hyperbolic cotangent of the argument.

Syntax
coth(z)

Description
The coth function calculates the hyperbolic cotangent of z. z may be any numeric expression that evaluates to a real number or a complex number.
Hyperbolic cotangent is defined as: coth(z) = 1/tanh(z) = cosh(z)/sinh(z) = (ez + e-z)/(ez - e-z)

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

acsch function

Returns the inverse hyperbolic cosecant of the argument.

Syntax
acsch(z)

Description
The acsch function calculates the inverse hyperbolic cosecant of z. z may be any numeric expression that evaluates to a real number or a complex number. acsch is the reverse of csch, i.e. acsch(csch(z)) = z.

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

asech function

Returns the inverse hyperbolic secant of the argument.

Syntax
asech(z)

Description
The asech function calculates the inverse hyperbolic secant of z. z may be any numeric expression that evaluates to a real number or a complex number. asech is the reverse of sech, i.e. asech(sech(z)) = z.

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

---

acoth function

Returns the inverse hyperbolic cotangent of the argument.

Syntax
acoth(z)

Description
The acoth function calculates the inverse hyperbolic cotangent of z. z may be any numeric expression that evaluates to a real number or a complex number. acoth is the reverse of coth, i.e. acoth(coth(z)) = z. For real numbers acoth is undefined in the interval [-1;1].

See also
Wikipedia [http://en.wikipedia.org/wiki/Hyperbolic_function]

Power and logarithm

sqr function

Returns the square of the argument.

Syntax
sqr(z)

Description
The sqr function calculates the square of z, i.e. z raised to the power of 2. z may be any numeric expression that evaluates to a real number or a complex number.

Label Format

exp function
Returns e raised to the power of the argument.

Syntax
exp(z)

Description
The exp function is used to raise e, Euler's constant, to the power of z. This is the same as e^z. z may be any numeric expression that evaluates to a real number or a complex number.

See also
Wikipedia [http://en.wikipedia.org/wiki/Exponential_function]

---

sqrt function

Returns the square root of the argument.

Syntax
sqrt(z)

Description
The sqrt function calculates the square root of z, i.e. z raised to the power of ½. z may be any numeric expression that evaluates to a real number or a complex number. If the calculation is done with real numbers,
the argument is only defined for z ^{3} 0.

See also
Wikipedia [http://en.wikipedia.org/wiki/Square_root]

---

root function

Returns the nth root of the argument.

Syntax
root(n, z)

Description
The root function calculates the nth root of z. n and z may be any numeric expression that evaluates to a real number or a complex number. If the calculation is done with real numbers, the argument is only defined
for z ^{3} 0.

Remarks
When the calculation is done with real numbers, the function is only defined for z<0 if n is an odd integer. For calculations with complex numbers, root is defined for the whole complex plane except at the pole n=0.

Label Format

Notice that for calculations with complex numbers the result will always have an imaginary part when z<0 even though the result is real when calculations are done with real numbers and n is an odd integer.
Example
Instead of x^(1/3), you can use root(3, x).

See also
Wikipedia [http://en.wikipedia.org/wiki/Nth_root]

---

ln function

Returns the natural logarithm of the argument.

Syntax
ln(z)

Description
The ln function calculates the logarithm of z with base e, which is Euler's constant. ln(z) is commonly known as the natural logarithm. z may be any numeric expression that evaluates to a real number or a complex number. If the calculation is done with real numbers, the argument is only defined for z>0. When calculating with complex numbers, z is defined for all numbers except z=0.

See also
Wikipedia [http://en.wikipedia.org/wiki/Natural_logarithm]

---

log function

Returns the base 10 logarithm of the argument.

Syntax
log(z)

Description
The log function calculates the logarithm of z with base 10. z may be any numeric expression that evaluates to a real number or a complex number. If the calculation is done with real numbers, the argument is only defined for z>0. When calculating with complex numbers, z is defined for all numbers except z=0.

See also
Wikipedia [http://en.wikipedia.org/wiki/Common_logarithm]

---

logb function

Returns the base n logarithm of the argument.

Syntax
logb(z, n)

Description
The logb function calculates the logarithm of z with base n. z may be any numeric expression that evaluates to a real number or a complex number. If the calculation is done with real numbers, the argument is only defined for z>0. When calculating with complex numbers, z is defined for all numbers except z=0. n must evaluate to a positive real number.

See also
Wikipedia [http://en.wikipedia.org/wiki/Logarithm]

Complex

abs function

Returns the absolute value of the argument.

Syntax
abs(z)

Description
The abs function returns the absolute or numeric value of z, commonly written as |z|. z may be any numeric expression that evaluates to a real number or a complex number. abs(z) always returns a positive real value.

See also
Wikipedia [http://en.wikipedia.org/wiki/Absolute_value]

---

arg function

Returns the argument of the parameter.

Syntax
arg(z)

Description
The arg function returns the argument or angle of z. z may be any numeric expression that evaluates to a real number or a complex number. arg(z) always returns a real number. The result may be in radians or degrees depending on the current settings. The angle is always between -p and p. If z is a real number, arg(z)
is 0 for positive numbers and p for negative numbers. arg(0) is undefined.

See also
Wikipedia [http://en.wikipedia.org/wiki/Arg_(mathematics)]

Label Format

conj function

Returns the conjugate of the argument.

Syntax
conj(z)

Description
The conj function returns the conjugate of z. z may be any numeric expression that evaluates to a real number or a complex number. The function is defined as: conj(z) = re(z) - i*im(z).

See also
Wikipedia [http://en.wikipedia.org/wiki/Complex_conjugation]

---

re function

Returns the real part of the argument.

Syntax
re(z)

Description
The re function returns the real part of z. z may be any numeric expression that evaluates to a real number or a complex number.

See also
Wikipedia [http://en.wikipedia.org/wiki/Real_part]

---

im function

Returns the imaginary part of the argument.

Syntax
im(z)

Description
The im function returns the imaginary part of z. z may be any numeric expression that evaluates to a real number or a complex number.

See also
Wikipedia [http://en.wikipedia.org/wiki/Imaginary_part]

Rounding

Label Format

trunc function

Removes the fractional part of the argument.

Syntax
trunc(z)

Description
The trunc function returns the integer part of z. The function removes the decimal part of z, i.e. rounds against zero. z may be any numeric expression that evaluates to a real number or a complex number. If z is a
complex number, the function returns trunc(re(z))+trunc(im(z))i.

See also
Wikipedia [http://en.wikipedia.org/wiki/Truncate]

---

fract function

Returns the fractional part of the argument.

Syntax
fract(z)

Description
The fract function returns the fractional part of z. The function removes the integer part of z, i.e. fract(z) = z - trunc(z). z may be any numeric expression that evaluates to a real number or a complex number. If z is a complex number, the function returns fract(re(z))+fract(im(z))i.

See also
Wikipedia [http://en.wikipedia.org/wiki/Floor_and_ceiling_functions#Fractional_part]

---

ceil function

Rounds the argument up.

Syntax
ceil(z)

Description
The ceil function finds the smallest integer not less than z. z may be any numeric expression that evaluates to a real number or a complex number. If z is a complex number, the function returns ceil(re(z))+ceil(im(z))i.

See also
Wikipedia [http://en.wikipedia.org/wiki/Floor_and_ceiling_functions]

Label Format

floor function

Rounds the argument down.

Syntax
floor(z)

Description
The floor function, which is also called the greatest integer function, gives the largest integer not greater than z. z may be any numeric expression that evaluates to a real number or a complex number. If z is a complex number, the function returns floor(re(z))+floor(im(z))i.

See also
Wikipedia [http://en.wikipedia.org/wiki/Floor_and_ceiling_functions]

---

round function

Rounds a number to the specified number of decimals.

Syntax
round(z,n)

Description
The round function rounds z to the number of decimals given by n. z may be any numeric expression that evaluates to a real number or a complex number. If z is a complex number, the function returns round(re(z),n)+round(im(z),n)i. n may be any numeric expression that evaluates to an integer. If n<0, z is rounded to n places to the left of the decimal point.
Examples
round(412.4572,3) = 412.457
round(412.4572,2) = 412.46
round(412.4572,1) = 412.5
round(412.4572,0) = 412
round(412.4572,-2) = 400

See also
Wikipedia [http://en.wikipedia.org/wiki/Rounding]

Piecewise

sign function

Returns the sign of the argument.

Syntax
sign(z)

Description
The sign function, which is also called signum, returns the sign of z. z may be any numeric expression that evaluates to a real number or a complex number. When z is a real number, sign(z) returns 1 for z>0 and -1 for z<0. sign(z) returns 0 for z=0. When z evaluates to a complex number, sign(z) returns z/abs(z).

See also
Wikipedia [http://en.wikipedia.org/wiki/Sign_function]

---

u function

The unit step function.

Syntax
u(z)

Description
u(z) is commonly known as the unit step function. z may be any numeric expression that evaluates to a real number. The function is undefined when z has an imaginary part. u(z) returns 1 for $z^{3}0$ and 0 for z<0.

See also
Wikipedia [http://en.wikipedia.org/wiki/Unit_step#Discrete_form]

---

min function

Finds and returns the minimum of the values passed as arguments.

Syntax
min(A,B,...)

Description
The min function returns the minimum value of its arguments. min can take any number of arguments not less than 2. The arguments may be any numeric expressions that evaluate to real numbers or complex numbers. If the arguments are complex numbers, the function returns min(re(A), re(B), ...) + min(im(A), im(B), ...)i.

---

max function

Finds and returns the maximum of the values passed as arguments.

Syntax
max(A,B,...)

Description
The max function returns the maximum value of its arguments. max can take any number of arguments

not less than 2. The arguments may be any numeric expressions that evaluate to real numbers or complex numbers. If the arguments are complex numbers, the function returns max(re(A), re(B), ...) + max(im(A), im(B), ...)i.

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range function

Returns the second argument if it is in the range between the first argument and the third argument.

Syntax
range(A,z,B)

Description
The range function returns z, if z is greater than A and less than B. If z < A then A is returned. If z > B then B is returned. The arguments may be any numeric expressions that evaluate to real numbers or complex
numbers. The function has the same effect as max(A, min(z, B)).

---

if function

Evaluates one or more conditions and returns a different result based on them.

Syntax
if(cond1, f1, cond2, f2, ... , condn, fn [,fz])

Description
The if function evaluates cond1 and if it is different from 0 then f1 is evaluated and returned. Else cond2 is evaluated and if it is different from 0 then f2 is returned and so forth. If none of the conditions are true fz is returned. fz is optional and if not specified if returns an error if none of the conditions are true. The arguments may be any numeric expressions that evaluate to real numbers or complex numbers.

Special

integrate function

Returns an approximation for the numerical integral of the given expression over the given range.

Syntax
integrate(f,var,a,b)

Description
The integrate function returns an approximation for the numerical integral of f with the variable var

from a to b. This is mathematically written as:

$$\int_a^b f(x)\,dx$$

This integral is the same as the area between the function f and the x-axis from a to b where the area under the axis is counted negative. f may be any function with the variable indicated as the second argument var. a and b may be any numeric expressions that evaluate to real numbers or they can be -INF or INF to indicate negative or positive infinity. integrate does not calculate the integral exactly. Instead the calculation is done using the Gauss-Kronrod 21-point integration rule adaptively to an estimated relative error
less than 10-3.

Examples
f(x)=integrate(t^2-7t+1, t, -3, 15) will integrate f(t)=t^2-7t+1 from -3 to 15 and evaluate to 396. More useful
is f(x)=integrate(s*sin(s), s, 0, x). This will plot the integral of f(s)=s*sin(s) from 0 to x, which is the same as the definite integral of f(x)=x*sin(x).

See also
Wikipedia [http://en.wikipedia.org/wiki/Integral]

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sum function

Returns the summation of an expression evaluated over a range of integers.

Syntax
sum(f,var,a,b)

Description
The sum function returns the summation of f where var is evaluated for all integers from a to b. This is mathematically written as:

$$\sum_{x=a}^{b} f(x)$$

f may be any function with the variable indicated as the second argument var. a and b may be any numeric expressions that evaluate to integers.

See also
Wikipedia [http://en.wikipedia.org/wiki/Summation]

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product function

Returns the product of an expression evaluated over a range of integers.

Syntax

Label Format

product(f,var,a,b)

Description
The product function returns the product of f where var is evaluated for all integers from a to b. This is mathematically written as:

$$\prod_{x=a}^{b} f(x)$$

f may be any function with the variable indicated as the second argument var. a and b may be any numeric expressions that evaluate to integers.

See also
Wikipedia [http://en.wikipedia.org/wiki/Multiplication#Capital_pi_notation]

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fact function

Returns the factorial of the argument.

Syntax
fact(n)

Description
The fact function returns the factorial of n, commonly written as n!. n may be any numeric expression that evaluates to a positive integer. The function is defined as fact(n)=n(n-1)(n-2)...1, and relates to the gamma function as fact(n)=gamma(n+1).

See also
Wikipedia [http://en.wikipedia.org/wiki/Factorial]

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gamma function

Returns the value of the Euler gamma function of the argument.

Syntax
gamma(z)

Description
The gamma function returns the result of the Euler gamma function of z, commonly written as G(z). z may be any numeric expression that evaluates to a real number or a complex number. The gamma function relates
to the factorial function as fact(n)=gamma(n+1). The mathematical definition of the gamma function is:

$$\Gamma(z) = \int_0^\infty t^{z-1} e^{-t} dt$$

This cannot be calculated precisely, so Graph is using the Lanczos approximation to calculate the gamma function.

See also
Wikipedia [http://en.wikipedia.org/wiki/Gamma_function]

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beta function

Returns the value of the Euler beta function evaluated for the arguments.

Syntax
beta(m, n)

Description
The beta function returns the result of the Euler beta function evaluated for m and n. m and n may be any numeric expressions that evaluate to real numbers or complex numbers. The beta function relates to the gamma function as beta(m, n) = gamma(m) * gamma(n) / gamma(m+n).

See also
Wikipedia [http://en.wikipedia.org/wiki/Beta_function]

W function

Returns the value of the Lambert W-function evaluated for the argument.

Syntax
W(z)

Description
The W function returns the result of the Lambert W-function, also known as the omega function, evaluated for
z. z may be any numeric expression that evaluates to a real number or a complex number. The inverse of the
W function is given by f(W)=W*eW.

Remarks
For real values of z when z < -1/e, the W function will evaluate to values with an imaginary part.

See also
Wikipedia [http://en.wikipedia.org/wiki/Lambert_w_function]

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zeta function

Returns the value of the Riemann Zeta function evaluated for the argument.

Syntax
zeta(z)

Description
The zeta function returns the result of the Riemann Zeta function, commonly written as z(s). z may be any numeric expression that evaluates to a real number or a complex number.

Remarks
The zeta function is defined for the whole complex plane except for the pole at z=1.

See also
Wikipedia [http://en.wikipedia.org/wiki/Riemann_zeta_function]

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mod function

Returns the remainder of the first argument divided by the second argument.

Syntax
mod(m,n)

Description
Calculates m modulo n, the remainder of m/n. mod calculates the remainder f, where m = a*n + f for some integer a. The sign of f is always the same as the sign of n. When n=0, mod returns 0. m and n may be any numeric expressions that evaluate to real numbers.

See also
Wikipedia [http://en.wikipedia.org/wiki/Modular_arithmetic]

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dnorm function

Returns the normal distribution of the first argument with optional mean value and standard deviation.

Syntax
dnorm(x, [μ,s])

Description
The dnorm function is the probability density of the normal distribution, also called Gaussian distribution. x is the variate, also known as the random variable, μ is the mean value and s is the standard deviation. μ and s are optional and if left out the standard normal distribution is used where μ=0 and s=1. x, μ and s may be any numeric expressions that evaluate to real numbers where s > 0. The normal distribution is defined as:

$$\mathrm{dnorm}(x, \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Label Format

See also
Wikipedia [http://en.wikipedia.org/wiki/Normal_distribution]