

SpaceTime 2.0 Documentation

www.spacetimemobile.com

May 4, 2006

Calculus Functions

Apart

$\text{Apart}(\text{function})$

Description:

Apart performs partial fraction decomposition on the polynomial *function*. It performs the opposite operation as Together.

Parameters:

function - Polynomial

Examples:

$$\text{Apart}((x^2+x+1)/((x-2)(x^2+3))) = \frac{1}{x-2} + \frac{1}{x^2+3}$$

$$\text{Apart}((2x^2+3x+5)/(x^2+2x+1)) = 2 - \frac{1}{x+1} + \frac{4}{[x+1]^2}$$

Clear

$\text{Clear}(\text{variable})$

Description:

Clear clears the value stored in *variable*.

Parameters:

variable - Variable

Cross

Cross(*vector1*, *vector2*)

Description:

Cross returns the cross product between *vector1* and *vector2*.

Parameters:

vector1 - List of 3 elements

vector2 - List of 3 elements

Examples:

$$\{1, 2, 3\} \times \{4, 5, 6\} = \text{Cross}(\{1,2,3\}, \{4,5,6\}) = [-3, 6, -3]$$

$$\{x_1, x_2, x_3\} \times \{y_1, y_2, y_3\} = \text{Cross}(\{x_1,x_2,x_3\},\{y_1,y_2,y_3\}) =$$
$$[-x_3 y_2 + x_2 y_3, -x_1 y_3 + x_3 y_1, -x_2 y_1 + x_1 y_2]$$

Curl

Curl(*function*)

Curl(*function*, *variables*)

Description:

Curl takes a *function* of three variables and returns a *function* of three elements. The default *variables* are $\{x, y, z\}$.

Parameters:

function - List of 3 elements

variable - List of 3 elements

Examples:

$$\text{Curl}\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right) = \text{Curl}(\{x/y, y/z, z/x\}) = \left[\frac{y}{z^2}, \frac{z}{x^2}, \frac{x}{y^2}\right]$$

$$\text{Curl}(\frac{t^2}{u}, uv, v+t) = \text{Curl}(\{t^2/u, v*u, v+t\}, \{t,u,v\}) = [-u, -1, \frac{t^2}{u^2}]$$

Degree

$\text{Degree}(\text{function}, \text{variable})$

Description:

Degree returns the highest degree power of *function*

Parameters:

function - Polynomial

variable - Character

Examples:

$$\text{Degree}(4x^5+3x-5, x) = 5$$

Determinant

$\text{Det}(\text{matrix})$

Description:

Determinant returns the determinant of *matrix*.

Parameters:

matrix - Square Matrix

Examples:

$$\text{Determinant}\left[\begin{pmatrix} a & b \\ c & d \end{pmatrix}\right] = \text{Det}(\{\{a,b\},\{c,d\}\}) = -b\ c+a\ d$$

Differentiate

$D(\text{function})$

$D(\text{function}, \text{variable})$

$D(\text{function}, \text{variable}, n)$

Description:

Differentiate returns the n -th derivative of *function* with respect to *variable*.
The default value of n is 1.

Parameters:

function - Expression, List, Matrix

variable - Character

n - Positive Integer

Examples:

$$\frac{d}{dx}(x^2) = D(x^2) = 2x$$

$$(5x + \cos(x))' = D(5x + \cos(x), x) = 5 - \sin(x)$$

$$\frac{d^4}{dz^4}(\sin(z)) = D(\sin(z), z, 4) = \sin(z)$$

Divergence

Divergence(*function*)

Divergence(*function*, *variable*)

Description:

Divergence returns the sum of the derivative of the i^{th} element of *function* with respect to the i^{th} element of *variable*. The default elements of *variable* are {x, y, z}.

Parameters:

function - Expression, List

variable - Character, List

Examples:

$$\text{Divergence}(3x y^2, y z, \frac{yz}{x}) = \text{Divergence}(\{3x^*y^2, y^*z, y^*z/x\}) = 3y^2 + z + \frac{y}{x}$$

$$\text{Divergence}(\{a * b^2, a^2 * b\}, \{a, b\}) = b^2 + a^2$$

$$\text{Divergence}(\{a * b^2, a^2 * b\}, \{b, a\}) = 4ab$$

Dot

$\text{Dot}(\text{vector1}, \text{vector2})$

Description:

Dot returns the dot product between two lists *vector1* and *vector2* or performs matrix multiplication of two matrices *vector1* and *vector2*.

Parameters:

vector1 - List, Matrix

vector2 - List, Matrix

Examples:

$$\{x1, x2, x3\} \bullet \{y1, y2, y3\} = \text{Dot}(\{x1, x2, x3\}, \{y1, y2, y3\}) = x1\ y1 + x2\ y2 + x3\ y3$$

$$\begin{bmatrix} 59 & -27 \end{bmatrix} \bullet \begin{bmatrix} x \\ y \end{bmatrix} = \text{Dot}(\{\{59, -27\}\}, \{\{x\}, \{y\}\}) = \begin{bmatrix} 59x - 27y \end{bmatrix}$$

$$\begin{bmatrix} 4 & 2 & 1 \\ 2 & 3 & 3 \\ 1 & 1 & 6 \end{bmatrix} \bullet \begin{bmatrix} 1 & 4 & 5 \\ 2 & 5 & 5 \\ 3 & 7 & 6 \end{bmatrix} = \text{Dot}(\{\{4, 2, 1\}, \{2, 3, 3\}, \{1, 1, 6\}\}, \{\{1, 4, 5\}, \{2, 5, 5\}, \{3, 7, 6\}\})$$

$$= \begin{bmatrix} 11 & 33 & 36 \\ 17 & 44 & 43 \\ 21 & 51 & 46 \end{bmatrix}$$

Duf

$\text{Duf}(\text{function}, \text{variable}, \text{point}, \text{direction})$

Description:

Duf returns the directional derivative of *function* with respect to *variable* at *point* in the direction *direction*.

Parameters:

function - Expression, List

variable - Character, List

Examples:

$$\text{Duf}(x^2*y^2*z^2, \{x,y,z\}, \{1,2,3\}, \{1,1,-2\}) = \frac{60}{\sqrt{(6)}}$$

Eigenvalues

Eigenvalues(*matrix*)

Description:

Eigenvalues returns the eigenvalues of *matrix*.

Parameters:

matrix - Square Matrix (Max Dimensions 3×3)

Examples:

$$\text{Eigenvalues}\left[\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}\right] = \text{Eigenvalues}(\{\{1,2\},\{2,3\}\}) = [2 - \sqrt{5}, 2 + \sqrt{5}]$$

$$\begin{aligned} \text{Eigenvalues}\left[\begin{pmatrix} -1 & -1 & 2 \\ 0 & 1 & -1 \\ 4 & -6 & 2 \end{pmatrix}\right] &= \text{Eigenvalues}(\{\{-1,-1,2\},\{0,1,-1\},\{4,-6,2\}\}) \\ &= [0, 5, -3] \end{aligned}$$

Expand

Expand(*function*)

Description:

Expand returns the expanded form of *function*.

Parameters:

function - Expression, List, Matrix

Examples:

$$\text{Expand}((x-1)(x-2)) = x^2 - 3x + 2$$

$$\text{Expand}((2x^2-y)(x-y-z)) = 2x^3 + y^2 - 2x^2y - 2x^2z - xy + yz$$

Factor

Factor(*function*)

Description:

Factor returns factored form of *function*

Parameters:

function - Expression, List, Matrix

Examples:

Factor(x^2-3x+2) = $[x-2][x-1]$

FSeries

FSeries(*function*, *variable*, *n*)

Description:

FSeries returns the first *n* terms of a Fourier Series of *function* with respect to *variable* in the interval $[-\pi, \pi]$.

Parameters:

function - Expression

variable - Character

n - Positive Integer

Examples:

FSeries($x/2$, x , 5) = $\sin(x) - \frac{\sin(2x)}{2} + \frac{\sin(3x)}{3} - \frac{\sin(4x)}{4} + \frac{\sin(5x)}{5}$

FSeries(x^2 , x , 2) = $\frac{\pi^2}{3} - 4\cos[x] + \cos[2x]$

Gradient

Gradient(*function*)

Gradient(*function*, *variable*)

Description:

Gradient returns a list of partial derivatives of the i^{th} element of *function*

with respect to the i^{th} element of *variable*. The default elements of *variable* are {x, y, z}.

Parameters:

function - Expression, List

variable - Character, List

Examples:

$$\text{Gradient}\left(\frac{xy^2}{z}\right) = \text{Gradient}(x*y^2/z) = \left[\frac{y^2}{z}, \frac{2xy}{z}, \frac{-xy^2}{z^2}\right]$$

$$\text{Gradient}\left(\frac{xy}{z}, yz^2, z^2x\right) = \text{Gradient}(\{x*y/z, y*z^2, z^2*x\}) =$$

$\frac{y^2}{z}$	$\frac{2xy}{z}$	$\frac{-xy^2}{z^2}$
0	z^2	$2yz$
z^2	0	$2xz$

$$\text{Gradient}(\{a/b, c*d^2, a^2*c\}, \{d, c\}) =$$

0	0
$2cd$	d^2
0	a^2

Hessian

Hessian(*function*)

Hessian(*function*, *variable*)

Hessian(*function*, *variable*, *point*)

Description:

Hessian returns the Hessian matrix of *function* with respect to *variable*. The default elements of *variable* are {x, y, z}.

Parameters:

function - Expression, List

variable - Character, List

point - Expression, List

Examples:

$$\text{Hessian}(x^2y^3/z^2) =$$

$\frac{2y^3}{z^2}$	$\frac{6xy^2}{z^2}$	$\frac{-4xy^3}{z^3}$
$\frac{6xy^2}{z^2}$	$\frac{6x^2y^2}{z^2}$	$\frac{-6x^2y^3}{z^3}$
$\frac{-4xy^3}{z^3}$	$\frac{-6x^2y^3}{z^3}$	$\frac{6x^2y^4}{z^4}$

$$\text{Hessian}(r^2x^2+s^3y^3, \{r,s\}) = \begin{array}{|c|c|} \hline 2x^2 & 0 \\ \hline 0 & 6sy^3 \\ \hline \end{array}$$

Identity

Identity(*integer*)

Description:

Identity returns the *integer* \times *integer* identity matrix.

Parameters:

integer - Positive Integer

Examples:

$$\text{Identity}(3) = \begin{array}{|c|c|c|} \hline 1 & 0 & 0 \\ \hline 0 & 1 & 0 \\ \hline 0 & 0 & 1 \\ \hline \end{array}$$

Integrate

$f(\textit{function})$

$f(\textit{function}, \textit{variable})$

$f(\textit{function}, \textit{variable}, \textit{lower bound}, \textit{upper bound})$

Note: Replacing f with Integrate will produce the same results

Description:

Integrate returns the indefinite (or definite) integral of *function* with respect to *variable* (evaluated from *lower bound* to *upper bound*). If *variable* is not specified Integrate will integrate *function* with respect to the variable it finds in the expression (and return an error if it detects more than one variable).

Parameters:

function - Expression, List, Matrix

variable - Character

lower bound - Expression

upper bound - Expression

Examples:

$$\int_1^2 3x^2 dx = f(3x^2, x, 1, 2) = 7$$

$$\int 2y dy = f(2y, y) = y^2$$

$$\int \frac{5}{t} dt = f(5/t) = 5 \ln(t)$$

$$\int (a * \cos(z) + b * \sin(y)) dz = f(a * \cos(z) + b * \sin(y), z) = a * \sin(z) + b * z * \sin(y)$$

$$\int_0^1 \int_0^{1-x} (x^2 + x * y + y^2 + y) dy dx = f(f(x^2 + x * y + y^2 + y, y, 0, 1 - x), x, 0, 1) = \frac{3}{8}$$

Inverse

Inverse(*matrix*)

Description:

Inverse returns the inverse matrix of *matrix*.

Parameters:

matrix - Square Matrix

Examples:

$$\text{Inverse}\left[\begin{pmatrix} a & b \\ c & d \end{pmatrix}\right] = \text{Inverse}(\{\{a,b\},\{c,d\}\}) = \begin{array}{|c|c|} \hline \frac{d}{-bc+ad} & -\frac{b}{-bc+ad} \\ \hline -\frac{c}{-bc+ad} & \frac{a}{-bc+ad} \\ \hline \end{array}$$

$$\text{Inverse}[\text{Inverse}\left[\begin{pmatrix} 1 & 5 & 6 \\ 2 & 4 & 5 \\ 1 & 1 & 7 \end{pmatrix}\right]] =$$

$$\text{Inverse}(\text{Inverse}(\{\{1,5,6\},\{2,4,5\},\{1,1,7\}\})) = \begin{array}{|c|c|c|} \hline 1 & 5 & 6 \\ \hline 2 & 4 & 5 \\ \hline 1 & 1 & 7 \\ \hline \end{array}$$

Jacobian

Jacobian(*function*)

Jacobian(*function*, *variable*)

Jacobian(*function*, *variable*, *point*)

Description:

Jacobian returns the Jacobian matrix of *function* with respect to *variable* evaluated at *point*. The default elements of *variable* are {x, y, z}.

Parameters:

function - Expression, List

variable - Character, List

point - Expression, List

Examples:

$$\text{Jacobian}(x^2 + y^2 + z^2) = \text{Jacobian}(x^2+y^2+z^2) = [2x, 2y, 2z]$$

$$\text{Jacobian}(\{x^2-y^2, 2x*y\}, \{x, y\}, \{3, 1\}) = \begin{array}{|c|c|} \hline 2x & -2y \\ \hline 2y & 2x \\ \hline \end{array}$$

$$\text{Jacobian}(\{x y z x1 x2 y3, \frac{x^2 y^2 z^2 x1 x2^2}{y3}\}, \{x, y, z, x1, x2, y3\}) =$$

$\frac{x1 x2 y y3 z}{y3}$	$\frac{x x1 x2 y3 z}{y3}$	$\frac{x x1 x2 y y3}{y3}$	$\frac{x x2 y y3 z}{y3}$	$\frac{x x1 y y3 z}{y3}$	$\frac{x x1 x2 y z}{y3^2}$
$\frac{2x x1 x2^2 y^2 z^2}{y3}$	$\frac{2x^2 x1 x2^2 y z^2}{y3}$	$\frac{2x^2 x1 x2^2 y^2 z}{y3}$	$\frac{x^2 x2^2 y^2 z^2}{y3}$	$\frac{2x^2 x1 x2 y^2 z^2}{y3}$	$\frac{-x^2 x1 x2^2 y^2 z^2}{y3^2}$

Laplacian

Laplacian(*function*)

Laplacian(*function*, *variable*)

Description:

Laplacian returns the sum of the second derivative of the i^{th} element of *function* with respect to the i^{th} element of *variable*. The default elements of *variable* are {x, y, z}.

Parameters:

function - Expression, List

variable - Character, List

Examples:

$$\text{Laplacian}(x^2 + y^2 + z^2) = \text{Laplacian}(x^2 + y^2 + z^2) = 6$$

$$\text{Laplacian}(5g^2/h - 3g^2, \{g, h\}) = \frac{10}{h} - 6 + \frac{10g^2}{h^3}$$

Limit

Limit(*function*, *point*)

Limit(*function*, *variable*, *point*)

Limit(*function*, *variable*, *point*, *direction*)

Description:

Limit returns the limit of *function* as *variable* approaches *point* from the direction *direction*. The default value of *direction* is 0 (i.e. Two-Sided Limit).

Parameters:

function - Expression, List, Matrix

variable - Character

point - Expression

direction - $\begin{cases} -1 & \text{Left-Sided Limit} \\ 0 & \text{Two-Sided Limit} \\ 1 & \text{Right-Sided Limit} \end{cases}$

Examples:

$$\lim_{x \rightarrow 1} \frac{x^2 - 1}{x - 1} = \text{Limit}((x^2-1)/(x-1), x, 1) = 2$$

$$\lim_{x \rightarrow \infty} \frac{5x^2 - x + 7}{3x^2 - 2} = \text{Limit}((5x^2-x+7)/(3x^2-2), x, \infty) = \frac{5}{3}$$

$$\lim_{x \rightarrow 0^-} \frac{1}{x} = \text{Limit}(1/x, x, 0, -1) = -\infty$$

$$\lim_{x \rightarrow 0^+} \frac{1}{x} = \text{Limit}(1/x, x, 0, 1) = \infty$$

$$\lim_{x \rightarrow \infty} \sin(x) = \text{Limit}(\sin(x), x, \infty) = \text{Interval}[-1, 1]$$

$$\lim_{x \rightarrow a} \frac{1}{x - a} = \text{Limit}(1/(x-a), x, a, 0) = \text{Error: The two-sided limit does not exist}$$

PolyDivide

PolyDivide(*numerator*, *denominator*)

Description:

PolyDivide returns the quotient and remainder from the polynomial division of *numerator* and *denominator*.

Parameters:

numerator - Polynomial

denominator - Polynomial

Examples:

$$\frac{x^2 + x + 6}{x + 7} = \text{PolyDivide}(x^2 + x + 6, x + 7) = [x - 6, 48]$$

$$(\text{Note: } \frac{x^2 + x + 6}{x + 7} = (x - 6) + \frac{48}{x + 7})$$

Product

Product(*function*, *variable*, *start*, *end*)

Description:

Product returns the product of *function* evaluated from *start* to *end* in integer increments.

Parameters:

function - Expression

variable - Character

start - Integer

end - Integer (\geq *start*)

Examples:

$$\prod_{a=1}^5 a^2 = \text{Product}(a^2, a, 1, 5) = 14400$$

$$\prod_{t=1}^3 \frac{1}{t^2} = \text{Product}(1/t^2, t, 1, 3) = \frac{1}{36}$$

QR

QR(*matrix*)

Description:

QR returns the QR factorization of *matrix*. The first element returned is the orthogonal matrix (usually denoted as Q), followed by the upper triangular matrix (R).

Parameters:

matrix - Square Matrix

Examples:

$$\text{QR}\left[\begin{pmatrix} 1 & 3 \\ 1 & -3 \end{pmatrix}\right] = \text{QR}(\{\{1,3\},\{1,-3\}\}) = \left[\begin{array}{cc|cc} \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & \sqrt{2} & 0 \\ \frac{1}{\sqrt{2}} & -\frac{1}{\sqrt{2}} & 0 & 3\sqrt{2} \end{array} \right]$$

Quotient

Quotient(*numerator*, *denominator*)

Description:

Quotient returns the quotient from the polynomial division of *numerator* and *denominator*.

Parameters:

numerator - Polynomial

denominator - Polynomial

Examples:

$$\text{Quotient}(x^2 + x + 6, x + 7) = x - 6$$

Remainder

Remainder(*numerator*, *denominator*)

Description:

Remainder returns the remainder from the polynomial division of *numerator* and *denominator*.

Parameters:

numerator - Polynomial

denominator - Polynomial

Examples:

$$\text{Remainder}(x^2 + x + 6, x + 7) = 48$$

RowReduce

RowReduce(*matrix*)

Description:

RowReduce performs Gaussian Elimination on *matrix*.

Parameters:

matrix - Matrix

Examples:

$$\text{RowReduce}\left[\begin{pmatrix} 1 & 2 & 3 \\ 2 & 5 & 6 \end{pmatrix}\right] = \text{RowReduce}(\{\{1,2,3\},\{2,5,6\}\}) = \begin{array}{|c|c|c|} \hline 1 & 0 & 3 \\ \hline 0 & 1 & 0 \\ \hline \end{array}$$

Series

Series(*function*, *variable*, *point*, *n*)

Description:

Series returns the first $n+1$ terms (i.e. a polynomial of degree n) of the Taylor series of *function* with respect to *variable* at *point*.

Parameters:

function - Expression

variable - Character

point - Expression

n - Positive Integer

Examples:

$$\text{Series}(\sin(x), x, 0, 5) = \frac{x^5}{120} - \frac{x^3}{6} + x$$

Sum

Sum(*function*, *variable*, *start*, *end*)

Description:

Sum returns the sum of *function* evaluated from *start* to *end* in integer increments.

Parameters:

function - Expression

variable - Character

start - Integer

end - Integer (\geq *start*)

Examples:

$$\sum_{n=1}^5 n^2 = \text{Sum}(n^2, n, 1, 5) = 55$$

$$\sum_{i=1}^{10} \frac{1}{i^2} = \text{Sum}(1/i^2, i, 1, 10) = \frac{1968329}{1270080}$$

Trace

Tr(*matrix*)

Description:

Trace returns the trace of *matrix*.

Parameters:

matrix - Square Matrix

Examples:

$$\text{Trace}\left[\begin{pmatrix} a & b \\ c & d \end{pmatrix}\right] = \text{Tr}(\{\{a,b\}, \{c,d\}\}) = a + d$$

$$\text{Trace}\left[\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}\right] = \text{Tr}(\{\{a,b,c\}, \{d,e,f\}, \{g,h,i\}\}) = a + e + i$$

Transpose

Transpose(*matrix*)

Description:

Transpose returns the transpose of *matrix*.

Parameters:

matrix - Matrix

Examples:

$$\text{Transpose}\left[\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix}\right] = \text{Transpose}(\{\{a,b,c\},\{d,e,f\},\{g,h,i\}\}) =$$

a	d	g
b	e	h
c	f	i

$$\text{Transpose}\left[\begin{pmatrix} a & b & c \\ d & e & f \end{pmatrix}\right] = \text{Transpose}(\{\{a,b,c\},\{d,e,f\}\}) =$$

a	d
b	e
c	f

Together

Together(*function*)

Description:

Together finds a common denominator for each additive term of a polynomial *function* and returns an equivalent expression with one numerator and one denominator. It performs the opposite operation as Apart.

Parameters:

function - Polynomial

Examples:

$$\text{Together}(2-1/(x+1)+4/(x+1)^2) = \frac{2x^2 + 3x + 5}{(x+1)^2}$$

$$\text{Together}(a/b + c/d) = \frac{ad + bc}{bd}$$

VectorAngle

VectorAngle(*vector1*, *vector2*)

Description:

VectorAngle returns the angle between *vector1* and *vector2*.

Parameters:

vector1 - List

vector2 - List

Examples:

VectorAngle({x1,x2,x3},{y1,y2,y3}) =

$$= \arccos\left(\frac{x_1 y_1 + x_2 y_2 + x_3 y_3}{\sqrt{(abs[x_1]^2 + abs[x_2]^2 + abs[x_3]^2)(abs[y_1]^2 + abs[y_2]^2 + abs[y_3]^2)}}\right)$$

VectorAngle({1,2,3,4},{2,5,6,3}) = $\cos^{-1}(\frac{21}{\sqrt{555}})$ ≈ 0.47037

VectorNorm

VectorNorm(*vector*) VectorNorm(*vector*, *P*)

Description:

VectorNorm returns the LP Norm of *vector*. The default value of *P* is 2.

Parameters:

vector - List *P* - Positive Integer

Examples:

$\|\{1,2,3,4\}\| = \text{VectorNorm}(\{1,2,3,4\}) = \sqrt{30}$

$\|\{x,y,z\}\|_{L1} = \text{VectorNorm}(\{x,y,z\}, 1) = abs[x] + abs[y] + abs[z]$

Distribution Functions

NormalPdf

NormalPdf(x)
NormalPdf(x , μ , σ)

Description:

Computes the normal probability density function at x with mean μ and standard deviation σ . The default values are $\mu = 0$ and $\sigma = 1$.

Parameters:

x - Real Number
 μ - Real Number
 σ - Positive Real Number

Definition:

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

NormalCDF

NormalCdf($lower$, $upper$)
NormalCdf($lower$, $upper$, μ , σ)

Description:

Computes the normal cumulative density function over the interval from $lower$ to $upper$ with mean μ and standard deviation σ . The default values are $\mu = 0$ and $\sigma = 1$.

Parameters:

$lower$ - Real Number
 $upper$ - Real Number
 μ - Real Number
 σ - Positive Real Number

Definition:

$$\text{NormalCdf}(\text{lower}, \text{upper}, \mu, \sigma) = \int_{\text{lower}}^{\text{upper}} \frac{1}{\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$

InverseNorm

InverseNorm(p)

Description:

Computes the x value to a corresponding area p using the inverse cumulative normal distribution function.

Parameters:

p - Real Number between 0 and 1

Definition:

$$p = \text{NormalCDF}(-\infty, x, \mu, \sigma) = \int_{\text{lower}}^{\text{upper}} \frac{1}{\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$

$$\text{InverseNorm}(p) = x$$

StudentTPdf

StudentTPdf(x, df)

Description:

Computes the Student-t probability density function at a value x with degrees of freedom df .

Parameters:

x - Real Number

df - Positive Real Number

Definition:

$$\text{StudentTPdf}(x, df) = \frac{\Gamma(\frac{df+1}{2})}{\Gamma(\frac{df}{2})} \frac{\frac{1+x^2}{df}^{\frac{df+1}{2}}}{\sqrt{\pi df}}$$

where $\Gamma(x)$ is the generalized factorial function defined by: $\Gamma(x) = \int_0^\infty t^{x-1} e^{-t} dt$

StudentTCdf

StudentTCdf(*lower*, *upper*, *df*)

Description:

Computes the Student-t cumulative density function over the interval defined by *lower* and *upper* with degrees of freedom *df*.

Parameters:

lower - Real Number

upper - Real Number

df - Positive Real Number

Definition:

$$\text{StudentTCdf}(\text{lower}, \text{upper}, \text{df}) = \int_{\text{lower}}^{\text{upper}} \frac{\Gamma(\frac{\text{df}+1}{2})}{\Gamma(\frac{\text{df}}{2})} \frac{\frac{1+x^2}{\text{df}} - \frac{\text{df}+1}{2}}{\sqrt{\pi \text{df}}} dx$$

ChiSquarePdf

ChiSquarePdf(*x*, *df*)

Description:

Computes the Chi-Square distribution's probability density function at the value *x* with degrees of freedom *df*.

Parameters:

x - Nonnegative Real Number

df - Positive Real Number

Definition:

$$\text{ChiSquarePdf}(x, \text{df}) = \frac{1}{\Gamma(\frac{\text{df}}{2})} \left(\frac{1}{2}\right)^{\frac{\text{df}}{2}} x^{\frac{\text{df}}{2}-1} e^{-\frac{x}{2}}$$

ChiSquareCdf

ChiSquareCdf(*lower*, *upper*, *df*)

Description:

Computes the Chi-Square distribution cumulative density function over the interval defined by *lower* and *upper* with degrees of freedom *df*.

Parameters:

lower - Nonnegative Real Number

upper - Nonnegative Real Number

df - Positive Real Number

Definition:

$$\text{ChiSquareTCdf}(\text{lower}, \text{upper}, \text{df}) = \int_{\text{lower}}^{\text{upper}} \frac{1}{\Gamma(\frac{\text{df}}{2})} \left(\frac{1}{2}\right)^{\frac{\text{df}}{2}} x^{\frac{\text{df}}{2}-1} e^{-\frac{x}{2}} dx$$

FRatioPdf

$\text{FRatioPdf}(x, \text{numerator } df, \text{denominator } df)$

Description:

Computes the F distribution probability density function at the value *x* with numerator degrees of freedom *numerator df* and denominator degrees of freedom *denominator df*.

Parameters:

x - Nonnegative Real Number

numerator df - Positive Real Number

denominator df - Positive Real Number

Definition:

$$\text{FRatioPdf}(x, n, d) = \frac{\Gamma(\frac{n+d}{2})}{\Gamma(\frac{n}{2}) \Gamma(\frac{d}{2})} \left(\frac{n}{d}\right)^{\frac{n}{2}} x^{\frac{n}{2}-1} \left(1 + \frac{nx}{d}\right)^{-\frac{n+d}{2}}$$

FRatioCdf

$\text{FRatioCdf}(\text{lower}, \text{upper}, \text{numerator } df, \text{denominator } df)$

Description:

Computes the F distribution cumulative density function over the interval

defined by *lower* and *upper* with numerator degrees of freedom *numerator df* and denominator degrees of freedom *denominator df*.

Parameters:

lower - Nonnegative Real Number

upper - Nonnegative Real Number

numerator df - Positive Real Number

denominator df - Positive Real Number

Definition:

$$\text{FRatioPdf}(\text{lower}, \text{upper}, n, d) = \int_{\text{lower}}^{\text{upper}} \frac{\Gamma(\frac{n+d}{2})}{\Gamma(\frac{n}{2})\Gamma(\frac{d}{2})} \left(\frac{n}{d}\right)^{\frac{n}{2}} x^{\frac{n}{2}-1} \left(1 + \frac{nx}{d}\right)^{-\frac{n+d}{2}} dx$$

BinomialPdf

BinomialPdf(*n*, *p*, *x*)

Description:

Computes the binomial distribution at *x* with number of trials *n* and probability of success *p* on each trial.

Parameters:

n - Positive Integer

p - Real Number between 0 and 1

x - Integer or List of Integers

Definition:

$$\text{BinomialPdf}(n, p, x) = \binom{n}{x} p^x (1-p)^{n-x}$$

BinomialCdf

BinomialCdf(*n*, *p*, *x*)

Description:

Computes the cumulative Binomial distribution at *x* with number of trials *n* and probability of success *p* on each trial.

Parameters:

n - Positive Integer

p - Real Number between 0 and 1

x - Integer or List of Integers

Definition:

$$\text{BinomialCdf}(n, p, x) = \sum_{i=0}^x \binom{n}{i} p^i (1-p)^{n-i}$$

PoissonPdf

$\text{PoissonPdf}(\mu, x)$

Description:

Computes the poisson distribution at x with mean μ .

Parameters:

μ - Positive Real Number

x - Integer or List of Integers

Definition:

$$\text{PoissonPdf}(\mu, x) = \frac{e^{-\mu} \mu^x}{x!}$$

PoissonCdf

$\text{PoissonCdf}(\mu, x)$

Description:

Computes the cumulative poisson distribution at x with mean μ .

Parameters:

μ - Positive Real Number

x - Integer or List of Integers

Definition:

$$\text{PoissonCdf}(\mu, x) = \sum_{i=0}^x \frac{e^{-\mu} \mu^i}{i!}$$

GeoPdf

GeoPdf(p, x)

Description:

Computes the geometric distribution at x with probability of success p .

Parameters:

p - Real Number between 0 and 1

x - Integer or List of Integers

Definition:

$$\text{GeoPdf}(p, x) = p(1 - p)^{x-1}$$

GeoCdf

GeoCdf(p, x)

Description:

Computes the geometric distribution at x with probability of success p .

Parameters:

p - Real Number between 0 and 1

x - Integer or List of Integers

Definition:

$$\text{GeoCdf}(p, x) = \sum_{i=0}^x p(1 - p)^{i-1}$$