

Examrace

Table to Find and Propagate Error or Uncertainty to Output from Inputs Based on Formula (Important)

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Rules for the evaluation of standard uncertainty through functional relationships with uncorrelated variables. Note how the error for both multiplication and division (6 and 4) is propagated using RMS value.

Rule	Notes (below)	Function	
1		$y = x_1 + x_2$	
2		$y = x_1 - x_2$	
3	$\frac{1}{2}$	$y = A + Bx_1 + Cx_2 \dots + Nx_n$	$u^2(y) = B^2u^2(x_1) + C^2u^2(x_2) + \dots + N^2u^2(x_n)$
4		$y = x_1/x_2$	
5	$\frac{1}{2}$	$y = Ax_1/Bx_2$	
6		$y = x_1 \times x_2$	
7	$\frac{1}{2}$	$y = Ax_1 \times Bx_2$	
8		$y = (x_1 \times x_2) / (x_3 \times x_4)$	$(u(y)/y)^2 = (u(x_1)/x_1)^2 + (u(x_2)/x_2)^2 + (u(x_3)/x_3)^2 + (u(x_4)/x_4)^2$
9	$\frac{1}{2}$	$y = x^A$	
10	$\frac{1}{2}$	$y = (x_1 / x_2)^A$	
11	$\frac{1}{2}$	$y = (x_1)^A \times (x_2)^B$	
12		$y = \ln x$	

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13	$\frac{1}{x}$	$y = A + \ln x$	
14	$\frac{1}{x}$	$y = A + \ln Bx^1 + \ln Cx^2$	
15	$\frac{1}{x}, \frac{2}{x}, \frac{3}{x}$	$y = \log_{10} x^A = A \log_{10} x$	
16	$\frac{1}{x}, \frac{2}{x}, \frac{3}{x}$	$y = A + \log_{10} x$	
17	$\frac{1}{x}, \frac{2}{x}, \frac{3}{x}$	$y = A + \log_{10} Bx^1 + \log_{10} Cx^2$	$u(y)$
18	$\frac{1}{x}, \frac{2}{x}$	$y = Ae^{Bx}$	
19	$\frac{4}{x}$	$y = x^w$	
20	$\frac{4}{x}$	$y = (x^1 / x^2)^w$ writing $q = x^1/x^2$ for brevity	$(u(y)/y)^2$
21	$\frac{5}{x}$	$y = f(x_1, x_2, \dots, x_n) g(x_1, x_2, \dots, x_n)$	$u^2(y) = (g \partial f / \partial x_i)^2$
22	$\frac{5}{x}$	$y = f(x_1, x_2, \dots, x_n) / g(x_1, x_2, \dots, x_n)$	$u^2(y) = (1/g)^2 [(g \partial f / \partial x_i)^2 + (f \partial g / \partial x_i)^2]$
23		$y = (\ln x^1 - \ln x^2) / (x^3 - x^4)$	$u^2(y)$
24	$\frac{1}{x}, \frac{4}{x}$	$y = a(bx^1)^{D1} (cx^2)^{D2}$	$(u(y)/y)^2 = (D_1 u(b)/b)^2 + (D_2 u(c)/c)^2$
25	$\frac{4}{x}$	$y = a(bx^1)^{w1} (cx^2)^{w2}$	$(u(y)/y)^2 = (w_1 u(b)/b)^2 + (w_2 u(c)/c)^2$

Standard Uncertainty

Notes:

¹ A, B, C, D, D_1, D_2 and N (all upper case) are constants with no uncertainty. They may be integers such as 2 or 3, a decimal number, a mathematical constant such as π , negative or positive.

² e is Euler's number and e^x is the exponential function. The value of e is approximately 2.7183.

³ $\log_{10}e$ is approximately 0.4343.

⁴ a, b, c, w, w_1 and w_2 (all lower case) are uncorrelated (measured) variables with random uncertainty components.

⁵ $x, x_1, x_2, x_3, \dots, x_n$ are all uncorrelated (measured) variables with random uncertainty components.

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