DATE

TOPIC

Uncertainty in the Volume of a Chocolate-Chip cookie.

$D = 8.50 \pm 0.02$ cm $h = 8.5 \times 10^{-2} \pm 0.005$ cm.

$V = \frac{\pi D^2}{4} h = 4.823 \text{ cm}^3$

$$dV = \frac{\pi}{4}\left(2D\,dD\,h + D^2\,dh\right) = \frac{\pi}{4}\left(D^2 h\right)\left(\frac{2\,dD}{D} + \frac{dh}{h}\right)$$

$$dV = V\left(\frac{2\,dD}{D} + \frac{dh}{h}\right)$$

① Using this approach $\Rightarrow$ $dV_1 = 0.306 \text{ cm}^3$

$$dV_2 = V\sqrt{\left(\frac{2\,dD}{D}\right)^2 + \left(\frac{dh}{h}\right)^2}$$

$\Rightarrow$ ② Using the statisical approach $dV_2 = 0.285 \text{ cm}^3$

$\frac{dV_2}{V} = 5.90\%$

Why is the 2nd technique the correct one?

Using the 1st technique (i.e., the bare-bones calculus approach)

Imagine $V = \frac{x}{t}$ $dv = \frac{1}{t}\,dx + \left(\frac{-x}{t^2}\right)dt$

uncertainty in the velocity $\Rightarrow$ $dv = \frac{x}{t}\left(\frac{dx}{x} - \frac{dt}{t}\right)$ using the 1st approach.

could $= 0$?? How can that be?? I can't !!