

**Question**

The volume of a cone with base radius  $r$  and height  $h$  is given by  $V = \frac{1}{3}\pi r^2 h$ . If the radius increases by 5% and the height decreases by 10%, find the approximate percentage change in  $V$ .

**Answer**

$$\begin{aligned}V &= \frac{1}{3}\pi r^2 h \\ \ln V &= \ln\left(\frac{\pi}{3}\right) + \ln r^2 + \ln h \\ &= \ln\left(\frac{\pi}{3}\right) + 2 \ln r + \ln h\end{aligned}$$

Take differentials

$$\frac{dV}{V} \approx 2\frac{dr}{r} + \frac{dh}{h}$$

In this question

$$\begin{aligned}\frac{dr}{r} &\approx 0.05 & \frac{dh}{h} &= -0.1 \\ \Rightarrow \frac{dV}{V} &\approx 2 \times 0.05 - 0.1 \approx 0\end{aligned}$$