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Course: MATH 100 (A01, A02, A03) Fall **Assignment:** Assignment 6
 2021

The diameter of a sphere is measured as 900 ± 3 cm and the volume is calculated from this measurement. Estimate the percentage error in the volume calculation.

Use the fact that the change in volume is approximately equal to the differential of the volume, $\Delta V \approx dV$, and the volume of a sphere is $\frac{4}{3}\pi r^3$, where $r = \frac{D}{2}$. Start by finding the volume of a sphere in terms of the diameter D .

$$\begin{aligned} V &= \frac{4}{3}\pi r^3 \\ &= \frac{4}{3}\pi \left(\frac{D}{2}\right)^3 \\ &= \frac{\pi D^3}{6} \end{aligned}$$

Next find the differential term dV of the volume, $V = \frac{\pi D^3}{6}$.

$$dV = \frac{\pi D^2}{2} dD$$

To find the percentage error in the volume calculation, evaluate V and dV at $D = 900$ and $dD = 3$.

$$\begin{aligned} V &= \frac{\pi D^3}{6} \\ &= \frac{\pi(900)^3}{6} \\ &= 121,500,000\pi \end{aligned}$$

Now evaluate dV at $D = 900$ and $dD = 3$.

$$\begin{aligned} dV &= \frac{\pi D^2}{2} dD \\ &= \frac{\pi(900)^2(3)}{2} \\ &= 1,215,000\pi \end{aligned}$$

Divide dV by V to find the error in the volume calculation.

$$\begin{aligned} \frac{dV}{V} &= \frac{1,215,000\pi}{121,500,000\pi} \\ &= 0.01 \end{aligned}$$

Now multiply by 100 to get the percent variation in terms of V .

There is approximately 1% error in the volume calculation.