

ERROR PROPAGATION

The radius of a sphere is measured as $r = 10 \text{ cm}$ with a measurement error of $\pm .1 \text{ cm} = dr$

Estimate

- a) The propagated error dv
 b) The relative error dv/v
 c) The percentage error $(dv/v) * 100\%$

in the calculation of the volume

$$a) \quad V = \frac{4}{3} \pi r^3 \Rightarrow \frac{dV}{dr} = \frac{4}{3} \pi \cdot 3r^2 = 4\pi r^2 \Rightarrow$$

$$\Rightarrow dv = 4\pi r^2 dr = 4\pi \times (10 \text{ cm})^2 (\pm .1 \text{ cm})$$

$$= \pm 40\pi \text{ cm}^3 \approx \pm 125.6 \text{ cm}^3$$

$$b) \quad \frac{dv}{V} = \frac{\pm 40\pi \text{ cm}^3}{\frac{4}{3} \pi (10 \text{ cm})^3} = \pm .03$$

$$\frac{dr}{r} = \frac{.1 \text{ cm}}{10 \text{ cm}} = \pm .01$$

$$c) \quad \frac{dv}{V} \times 100\% = \pm .03 * 100\% = \pm 3\%$$

$$\frac{dr}{r} \times 100\% = \pm .01 * 100\% = \pm 1\%$$