# DETERMINING THE SAMPLE SIZE NEEDED TO ACHIEVE A CERTAIN MARGIN OF ERROR

$$\bar{x} \pm ME \begin{cases} \sigma \text{ known} & \bar{x} \pm z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}} \checkmark \\ \sigma \text{ unkown} & \bar{x} \pm t_{\alpha/2} \dfrac{s}{\sqrt{n}} \end{cases}$$

$ME = 2{,}000$ $\qquad ME = z_{\alpha/2} \dfrac{\sigma}{\sqrt{n}} \Rightarrow$

$$\Rightarrow \sqrt{n} = z_{\alpha/2} \frac{\sigma}{ME} \Rightarrow \boxed{n = \left( \frac{z_{\alpha/2}\, \sigma}{ME} \right)^2}$$

$CL = 95\% \Rightarrow \alpha = .05$

$\alpha/2 = .025 \quad z_{\alpha/2} = 1.96 \qquad \sigma = 5{,}000$

$$n = \left( \frac{1.96 \times 5{,}000}{2{,}000} \right)^2 = 24.01 \approx 25$$

ALWAYS ROUND UP

What if $\sigma$ is unknown?

$$ME = t_{\alpha/2} \frac{s}{\sqrt{n}} \Rightarrow \sqrt{n} = \frac{t_{\alpha/2} \cdot s}{ME} \Rightarrow$$

$$\boxed{n = \left( \frac{t_{\alpha/2} \cdot s}{ME} \right)^2}$$

## For Proportions

$$\hat{p} \pm \underbrace{Z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}}_{ME} \Rightarrow ME = Z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$$

$$\Rightarrow ME^2 = Z_{\alpha/2}^2\,\frac{\hat{p}\,\hat{q}}{n} \Rightarrow \boxed{n = \frac{Z_{\alpha/2}^2\,\hat{p}\,\hat{q}}{ME^2}}$$

## Example:

Auto Tire Dealer $\qquad n = ?$

$CL = 95\%$

$Z_{\alpha/2} = 1.96$

$ME = .05$

$$n = \frac{1.96^2 \times .50 \times .50}{.05^2}$$

$$= 384.16 \approx 385$$

$\hat{P} = .10$

$$n = \frac{1.96^2 \times .10 \times .90}{.05^2}$$

$$= 138.3 \approx 139$$