These will be given to you on Quiz 4. You will need to understand them, though!

**Sample Proportion of Successes**

\[ \hat{p} = \frac{x}{n} \]

\((1 - \alpha)\) **Confidence Interval (CI) for \(\mu\), where \(\sigma\) is Known**

(Assume the Central Limit Theorem (CLT) applies.)

\[ \mu = \bar{x} \pm E \]

where the **margin of error**

\[ E = z_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right) \]

That is,

\[ \mu = \bar{x} \pm z_{\alpha/2} \left( \frac{\sigma}{\sqrt{n}} \right) \]

**Rounding Rule for \(E\)**

Round off (or up) the margin of error \(E\) to the **same number of decimal places** as the given value of \(\bar{x}\).

**Determining Sample Size \(n\) for Estimating \(\mu\)**

For a \((1 - \alpha)\) **confidence level** and a desired **margin of error** \(E\),

the required sample size \(n\) is given by:

\[ n = \left\lceil \left( \frac{z_{\alpha/2} \sigma}{E} \right)^2 \right\rceil \]

where \(\lceil \cdot \rceil\) is the ceiling (or “round-up”) operator.

*(SEE NEXT PAGE!)*
(1 − α) Confidence Interval (CI) for $\mu$, where $\sigma$ is Unknown

(1 − α) Confidence Interval (CI) for $\mu$, where $\sigma$ is Unknown

(Assume the Central Limit Theorem (CLT) applies.)

$$\mu = \bar{x} \pm E$$

where the margin of error

$$E = t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right)$$

That is,

$$\mu = \bar{x} \pm t_{\alpha/2} \left( \frac{s}{\sqrt{n}} \right)$$

We use the $t$ distribution on $(n - 1)$ degrees of freedom (df).

Rounding Rule for $E$

Round off (or up) the margin of error $E$ to the same number of decimal places as the given value of $x$.

(1 − α) Confidence Interval (CI) for $p$

(Assume $X \sim \text{Bin}(n, p)$. To justify a normal approximation, verify: $n\hat{p} \geq 5$, and $n\hat{q} \geq 5$.)

$$p = \hat{p} \pm E$$

where the margin of error

$$E = z_{\alpha/2} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

That is,

$$p = \hat{p} \pm z_{\alpha/2} \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

(SEE NEXT PAGE!)
Determining Sample Size \( n \) for Estimating \( p \)

For a \( (1-\alpha) \) confidence level and a desired margin of error \( E \),
the conservative estimate for the required sample size \( n \) is given by:

\[
  n = \left\lceil \frac{\left( \frac{z_{\alpha/2}}{2} \right)^2 \left( 0.25 \right)}{E^2} \right\rceil
\]

where \( \lceil \cdot \rceil \) is the ceiling (or “round-up”) operator.

\( (1-\alpha) \) Confidence Intervals (CIs) for \( \sigma^2 \) and \( \sigma \)

(assume \( X \sim \text{Normal} \).)

\[
\frac{(n-1)s^2}{\chi^2_R} < \sigma^2 < \frac{(n-1)s^2}{\chi^2_L}
\]

\[
\frac{(n-1)s^2}{\chi^2_R} < \sigma < \frac{(n-1)s^2}{\chi^2_L}
\]

We use the \( \chi^2 \) distribution on \( (n-1) \) degrees of freedom (df).

\( \chi^2_R \) is the right (greater) CV.

\( \chi^2_L \) is the left (lesser) CV.

Rounding Rule for the Limits of the CIs

Round off (or “out”) the limits of the CIs to the same number of decimal places as the given value of \( s^2 \) or \( s \).