1a) The formula for a confidence interval for a sample proportion is: $\hat{p} \pm z^*(\sqrt{(\hat{p}(1-\hat{p})/n)})$

Where:

- $\hat{p}$ is the sample proportion
- z^* is the critical value (1.96 for 95% confidence level)
- n is the sample size

1b) To ensure the confidence interval captures the population parameter, we can:

- Increase the sample size (n)
- Increase the confidence level (which increases z^*)
- Ensure random sampling is used the graph shows one interval (in red) that missed the true population parameter of 0.88, which is expected since 95% confidence means approximately 1 in 20 intervals will miss the true parameter.

2. Conditions for CLT (Central Limit Theorem):

When population is normal:

- Random sampling
- Independent observations
- $n > 30$ is preferred but not strictly necessary

When population distribution is unknown:

- Random sampling
- Independent observations

- $n > 30$ (for approximately normal sampling distribution)
- Success-failure condition: $np \geq 10$ and $n(1-p) \geq 10$ for proportions

For very large samples ($n > 1000$):

- Random sampling remains crucial
- Independence becomes less strict (can sample up to 10% of population)
- Almost any population distribution shape is acceptable

3. The difference between standard error and margin of error:

Standard error (SE) measures the variability of the sample statistic (like a sample proportion) across different possible samples. It's calculated as $\sqrt{\hat{p}(1-\hat{p})/n}$ for proportions.

Margin of error (ME) is the product of the standard error and the critical value (z^*). $ME = z^*SE$. It represents the maximum expected difference between the sample statistics and population parameter at the chosen confidence level.

In practical terms, standard error is a measure of precision, while margin of error tells us how far our estimate might be from the true population value given our desired confidence level.

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