The Central Limit Theorem.

From a population of quantities \( x \) with mean \( \mu \) and std. dev. \( \sigma \), consider the sampling distribution of all sample means \( \bar{x} \) from samples of this population with size \( n \).

The mean of the sampling distribution is \( \mu_{\bar{x}} \) and the standard error (deviation) is \( \frac{\sigma}{\sqrt{n}} \). The following can be proven:

1. The sample means \( \bar{x} \) are approximately normal if \( n \geq 30 \) or you’re sampling from a normal population.

2. \( \mu_{\bar{x}} = \mu \).

3. \( \frac{\sigma}{\sqrt{n}} \) is the standard error in \( \bar{x} \) values.

Margin of Error

\[
E = z_{\alpha/2} \cdot \frac{\sigma}{\sqrt{n}}.
\]

Confidence interval: estimate - E < unknown parameter < estimate + E

\[
\bar{x} - E < \mu < \bar{x} + E.
\]