# Sampling Error

(Margin of Error)

* The difference between the point estimate ($\bar{x}$) and the actual value of the parameter.
* **Margin of Error E** – the greatest possible error (or distance) between the point estimate ($\bar{x}$) and the value of the parameter. ($\mu$)
    * The maximum area: $\bar{x} - \mu$

# To find the Margin of Error:

* Use the formula: $E = z_c\left(\frac{\sigma}{\sqrt{n}}\right)$

  E = margin of error
  $z_c$ = critical values
  $\sigma$ = pop. standard deviation
  n = sample size

* As long as these conditions are met:
* The sample is random.
* The population is normally distributed
  OR $n \geq 30$.

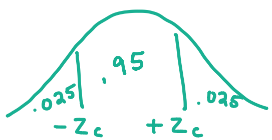
# EX:

* You take a random sample of 40 employees from several grocery stores to find the mean number of hours worked. Use a 95% confidence level to find the margin of error for the mean number of hours worked by grocery store employees. Assume the population standard deviation is 7.9 hours.

$n = 40$

$c = 0.95 \longrightarrow$ Area to find $z_c$

$\sigma = 7.9$




$z_c = 1.96$
(use calc)

$$E = 1.96\left(\frac{7.9}{\sqrt{40}}\right)$$

$$\boxed{E = 2.4 \text{ hours}}$$

* Pop. mean will differ from sample mean by at most 2.4 hours → We can say this with 95% confidence.

# Confidence Intervals for a Population Mean

- Using the point estimate ($\bar{x}$) and the margin of error ($E$), you can construct an interval estimate of a population parameter (such as the mean $\mu$)
- This interval is called a confidence interval for a population mean $\mu$:

$$\underbrace{\bar{x} - E < \mu < \bar{x} + E}_{}$$

Confidence Interval: interval in which pop. mean should fall

# Constructing a Confidence Interval for a Population Mean (with known standard deviation):

* 1) Make sure that $\sigma$ (pop. SD) is known, the sample is random, and that either the population is normally distributed or that $n \geq 30$.
* 2)Find the sample statistics $n$ and $\bar{x}$:

Sample mean: $\bar{x} = \dfrac{\text{All } x\text{'s added up}}{n}$

(if not given $\bar{x}$)

* 3)Find the critical value ___$z_c$___ that corresponds to the given ___level of confidence (c written as a %)___.

  * Calc → invsnorm

* 4) Find the margin of error ___E___:

$$E = z_c\left(\frac{\sigma}{\sqrt{n}}\right)$$

* 5) Find the left and right endpoints and form the confidence interval:

$$\bar{x} - E < \mu < \bar{x} + E$$

left endpoint: subtract $E$ from $\bar{x}$

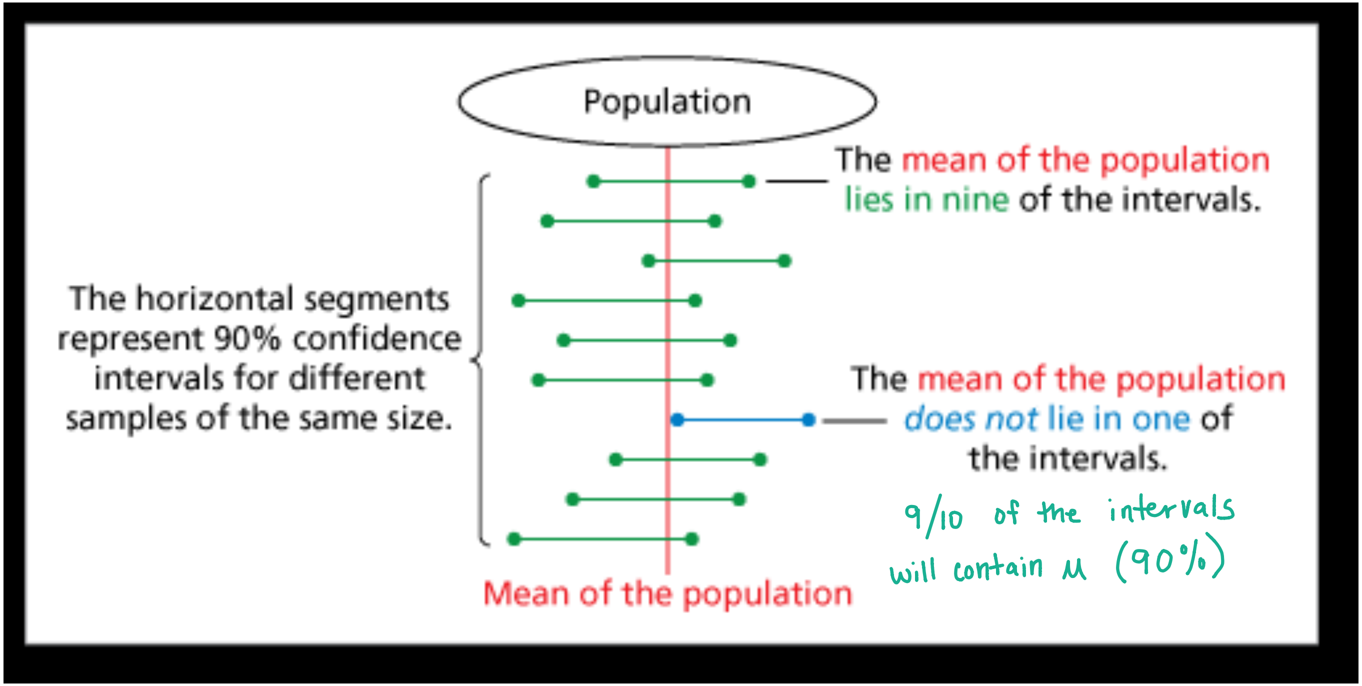
right endpoint: add $E$ to $\bar{x}$

# EX:

* A college admissions director wishes to estimate the mean age of all students currently enrolled. In a random sample of 20 students, the mean age is found to be 22.9 years. From past studies, the standard deviation is known to be 1.5 years, and the population is normally distributed. Construct a 90% confidence interval of the population mean age.

# Interpreting the Confidence Interval from Previous Example

* "With 90% confidence, the mean is in the interval (22.3 , 23.5)
* This means: When a ___large number___ of samples is collected and a ___confidence___ ___interval___ is created for each sample, ___approximately 90%___ of these ___intervals___ will contain ___$\mu$ (pop. mean)___.




9/10 of the intervals will contain $\mu$ (90%)