Abe Mirza **Estimating population proportion** Statistics

Point and Interval Estimate $P = \hat{p} \pm E$

a) What do we estimate? Population percentage ($\boldsymbol{P}$) or sample mean ($\hat{\boldsymbol{P}}$) or both?
b) Why do we need to estimate? Cite some reasons?
c) What is the point estimate?
d) What is the confidence level?
e) What is the margin of error formula for estimation population proportion?
f) What is the width of a confidence interval?
g) How we can use the width of a confidence interval to find point estimate?
h) How we can use the width of a confidence interval to find margin of error?
i) How to use **TI calculator** to find the boundaries of a confidence interval when we use **normal distribution**?

YouTube TI Calculator: https://www.youtube.com/watch?v=OVc5BCa0UvQ **General introduction**
YouTube TI Calculator: https://www.youtube.com/watch?v=e3HZ6Xv-plk **General introduction**

A) For the following problems **find the margin of error** by using the **below formula** and the **table on page 7**?

$$E = Z_{\alpha/2}\left(\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}\right)$$

A-1) Sample size $\boldsymbol{n = 64}$, $\boldsymbol{x = 16}$ and 90% confidence level? $E = 0.029$
A-2) Sample size $\boldsymbol{n = 64}$, $\boldsymbol{x = 16}$ and 95% confidence level? $E = 0.1061$
A-3) Sample size $\boldsymbol{n = 100}$, $\boldsymbol{x = 45}$ and 95% confidence level? $E = 0.0975$
A-4) Sample size $\boldsymbol{n = 400}$, $\hat{\boldsymbol{p}} = \boldsymbol{.5}$ and 97% confidence level? $E = 0.0543$
A-5) Sample size $\boldsymbol{n = 200}$, $\hat{\boldsymbol{p}} = \boldsymbol{.40}$ and the 90% confidence level? $E = 0.057$
Solution on page 3.

Fill in the blanks with one of the following: *increases, decreases,* or *stays the same* where.
1) As the sample size (n) increase, the margin of error (E) __________________?
As the confidence level (C) increase, the margin of error (E) __________________?

1. If 60% of a sample of 400 people leaving a shopping mall claims to have spent over $25, determine a 90% confidence interval estimate for the proportion of shopping mall customers who spend over $25. Interpret your interval.

2. In a random sample of machine parts, 18 out of 225 were found to have been damaged in shipment. Establish a 95% confidence interval estimate for the proportion of machine parts that are damaged in shipment. Interpret your interval.

3. A telephone survey of 1000 adults was taken shortly after the U.S. began bombing Iraq. If 832 voiced their support for this action. Create a 99% confidence interval and interpret the interval.

4. An assembly line does a quality check by sampling 50 of its products. It finds that 16% of the parts are defective.

a. Create a 95% confidence interval for the percent of defective parts for the company and interpret this interval.

b. If we decreased the confidence level to 90% **what would happen to:**

   i. **the critical value?**
   ii. **the margin of error?**
   iii. **the confidence interval?**

c. If the sample size were increased to 200, the same sample proportion were found, and we did a 95% confidence interval; **what would happen to**:

   i. **the critical value?**
   ii. **the margin of error?**
   iii. **the confidence interval?**

5. A nationwide poll was taken of 1400 teenagers (ages 13-18). 630 of them said they have a TV in their room.

a. Create a 90% confidence interval for the proportion of all teenagers who have a TV in their room and interpret it.

What does "90% confidence" mean in this context?
If we increased the confidence level to 99% **what would happen to**:

   i. **the critical value?**
   ii. **the margin of error?**
   iii. **the confidence interval?**

6. If the sample size were changed to 950, the same sample proportion were found, and we did a 90% confidence interval; what would happen to:

   ii. **the critical value?** By just decreasing the sample size the critical value will not change
   iii. **the margin of error?** It will increase
   iv. **the confidence interval?** It will become wider.

7. Suppose a 90% confidence interval is stated as (0.3011, 0.4189).

a. What is the sample proportion from this sample? $\hat{p} = (UB + LB)/2 = (0.4189 + 0.3011)/2 = 0.36$

b. What is the margin of error? $E = (UB - LB)/2 = (0.4189 - 0.3011)/2 = 0.0580$

c.

A-1) Sample size $\boldsymbol{n = 64}$, $\boldsymbol{x = 16}$ and 90% confidence level? $E = 0.089$

$$\hat{p} = \frac{x}{n} = \frac{16}{64} = 0.25 \qquad E = 1.645\sqrt{\frac{0.25(1-0.25)}{64}} = 0.089$$

A-2) Sample size $\boldsymbol{n = 50}$, $\boldsymbol{x = 24}$ and 95% confidence level? $E = 0.1061$

$$\hat{p} = \frac{x}{n} = \frac{16}{64} = 0.25 \qquad E = 1.96\sqrt{\frac{0.25(1-0.25)}{64}} = 0.1061$$

A-3) Sample size $\boldsymbol{n = 80}$, $\boldsymbol{x = 32}$ and 95% confidence level? $E = 0.0975$

$$\hat{p} = \frac{x}{n} = \frac{45}{100} = 0.45 \qquad E = 1.96\sqrt{\frac{0.45(1-0.45)}{100}} = 0.0975$$

A-4) Sample size $\boldsymbol{n = 100}$, $\boldsymbol{\hat{p} = .6}$ and 97% confidence level? $E = 0.0543$

$$E = 2.17\sqrt{\frac{0.50(1-0.50)}{400}} = 0.543$$

A-5) Sample size $\boldsymbol{n = 320}$, $\boldsymbol{\hat{p} = .45}$ and the 90% confidence level? $E = 0.057$

$$E = 1.645\sqrt{\frac{0.40(1-0.40)}{200}} = 0.057$$

1. $E = 1.645\sqrt{\frac{0.60(1-0.60)}{400}} = .0403$ $\quad P = 0.60 \pm 0.0403 \quad 56\% < P < 64\%$

2. $\hat{p} = \frac{x}{n} = \frac{18}{225} = 0.08$ $\quad E = 1.96\sqrt{\frac{0.08(1-0.08)}{225}} = .0354$ $\quad P = 0.08 \pm 0.0354 \quad 4.5\% < P < 11.5\%$

3. $\hat{p} = \frac{x}{n} = \frac{832}{1000} = 0.832$ $\quad E = 2.5758\sqrt{\frac{0.832(1-0.832)}{1000}} = .0305$ $\quad P = 0.832 \pm 0.0305 \quad 80.16\% < P < 86.25\%$

4. $E = 1.96\sqrt{\frac{0.16(1-0.16)}{50}} = .102$ $\quad P = 0.16 \pm 0.102 \quad 0.06\% < P < 26.16\%$

b. If we decreased the confidence level to 90% **what would happen to:**
   i. **the critical value?** It decreases from 1.96 to 1.645
   ii. **the margin of error?** It will decrease
   iii. **the confidence interval?** It will become narrower

c. If the sample size were increased to 200, the same sample proportion were found, and we did a 95% confidence interval; **what would happen to**:
   i. **the critical value?** By just increasing the sample size the critical value will not change
   ii. **the margin of error?** By increasing sample size the margin of error will decrease.
   iii. **the confidence interval?** By increasing sample size the interval will be narrower.

5. A nationwide poll was taken of 1400 teenagers (ages 13-18). 630 of them said they have a TV in their room.

a.

$\hat{p} = \frac{x}{n} = \frac{630}{1400} = 0.45$ $\quad E = 1.645\sqrt{\frac{0.45(1-0.45)}{1400}} = .0133$ $\quad P = 0.45 \pm 0.0133 \quad 43.67\% < P < 46.33\%$

What does "90% confidence" mean in this context?

If we increased the confidence level to 99% **what would happen to**:
   iv. **the critical value?** It increases 1.645 to 2.5758
   v. **the margin of error?** It will increase.
   vi. **the confidence interval?** It will become wider.

6. If the sample size were changed to 950, the same sample proportion were found, and we did a 90% confidence interval; what would happen to:
   v. **the critical value?** By just decreasing the sample size the critical value will not change
   vi. **the margin of error?** It will increase
   vii. **the confidence interval?** It will become wider.

2. Suppose a 90% confidence interval is stated as (0.3011, 0.4189).
   a. What is the sample proportion from this sample? $\hat{p} = (UB + LB) / 2 = (0.4189 + 0.3011) / 2 = 0.36$
   b. What is the margin of error? $E = (UB - LB) / 2 = (0.4189 - 0.3011) / 2 = 0.0580$