2024 AP Statistics Exam #1

1. A large exercise center has several thousand members from age 18 to 55 years and several thousand members age 56 and older. The manager of the center is considering offering online fitness classes. The manager is investigating whether members' opinions of taking online fitness classes differ by age. The manager selected a random sample of 170 exercise center members ages 18 to 55 years and a second random sample of 230 exercise center members ages 56 years and older. Each sampled member was asked whether they would be interested in taking online fitness classes.

   The manager found that 51 of the 170 sampled members ages 18 to 55 years and that 79 of the 230 sampled members ages 56 years and older said they would be interested in taking online fitness classes.

   At a significance level of $\alpha = 0.05$, do the data provide convincing statistical evidence of a difference in the proportion of all exercise center members ages 18 to 55 years who would be interested in taking online fitness classes and the proportion of all exercise center members ages 56 years and older who would be interested in taking online fitness classes? Complete the appropriate inference procedure to justify your response.

CHOOSE two-sample z-test for difference of proportions

$H_0: P_1 = P_2$
$H_a: P_1 \neq P_2$

P_1 = proportion of all exercise center members ages 18-55 who would be interested in taking online fitness classes

P_2 = proportion of all exercise center members ages 56 and older who would be interested in taking online fitness classes

CHECK

Random: independent random samples ✓

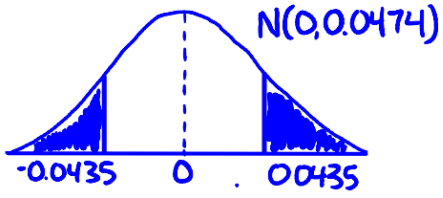
10%: $170 \leq 0.10$(several thousand members age 18 to 55)
$230 \leq 0.10$(several thousand members age 56 and older) ✓

Large Counts: $170(0.325) = 55.25 \geq 10$ $230(0.325) = 74.75 \geq 10$
$170(0.675) = 114.75 \geq 10$ $230(0.675) = 155.25 \geq 10$ ✓

CALCULATE

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\hat{p}_c(1-\hat{p}_c)}{n_1} + \frac{\hat{p}_c(1-\hat{p}_c)}{n_2}}}$$

$$z = \frac{(0.30 - 0.3435) - 0}{\sqrt{\frac{(0.325)(0.675)}{170} + \frac{(0.325)(0.675)}{230}}}$$



$z = -0.92$

p-value = $0.1788 \times 2 = 0.3576$

CONCLUDE

Because $0.3576 > 0.05$ we fail to reject H_0 and do not have convincing evidence of a difference in the proportion of all exercise center members ages 18 to 55 years who would be interested in taking online fitness classes and the proportion of all exercise center members ages 56 and older who would be interested in taking online fitness classes.

2024 #1 - Section 1

QuickNotes
1. Identify procedure
2. Correct hypotheses
3. Context

Student response #1

$H_0: p_1 - p_2 = 0$
$H_a: p_1 - p_2 \neq 0$

$p_1 - p_2$ = true difference in proportion of all exercise center members who would be interested in taking fitness classes (age 18 to 55 – age 56+)

$$z = \frac{0.3 - 0.3435}{\sqrt{0.325(1-0.325)}\sqrt{\frac{1}{170} + \frac{1}{230}}}$$

Component 1?

Component 2?

Component 3?

E, P, or I?

Student response #2

two-sample z-test for $\hat{p}_1 - \hat{p}_2$

H_0: There is no difference between all exercise members ages 18-55 who would be interested in taking online fitness classes and all exercise members age 56+ who would be interested in taking online fitness classes.

H_a: There is a difference.

Component 1?

Component 2?

Component 3?

E, P, or I?

Student response #3

2-PropZTest

$H_0: \hat{p}_1 = \hat{p}_2$
$H_a: \hat{p}_1 \neq \hat{p}_2$

$\hat{p}_1$ = proportion of exercise center members ages 18-55 who said they are interested in taking online fitness classes

$\hat{p}_2$ = proportion of exercise center members ages 56 and older who said they are interested in taking online fitness classes

Component 1?

Component 2?

Component 3?

E, P, or I?

2024 #1 - Section 2

QuickNotes
1. Independence condition
2. Large Counts condition
3. Correct z-statistic
4. Correct *p*-value

Student response #1

- random sample ✓
- there are more than 1700 members age 18 to 55 and more than 2300 members age 56 and older. ✓
- $170(0.325) \geq 10$ $230(0.325) \geq 10$
  $170(0.675) \geq 10$ $230(0.675) \geq 10$ ✓

$z = -0.92$

p-value = 0.3576

Component 1?

Component 2?

Component 3?

Component 4?

E, P, or I?

Student response #2

2-PropZTest

$H_0: p_1 = p_2$

$H_a: p_1 < p_2$

- SRSs ✓
- members 18-55 ≥ 1700, members 56+ ≥ 2300 ✓
- 55.25, 114.75, 74.75, 155.25 ≥ 5 ✓

$z = -0.92$ p-value = 0.1788

Component 1?

Component 2?

Component 3?

Component 4?

E, P, or I?

Student response #3

members age 18-55

- random sample
- 170 ≤ 10%.(all members 18-55)
- $170(0.325) = 55.25$
  $170(1-0.325) = 114.75$

p-value = 0.3576

members age 56 and older

- random sample
- 230 ≤ 10%.(all members 56+)
- $230(0.325) = 74.75$
  $230(1-0.325) = 155.25$

Component 1?

Component 2?

Component 3?

Component 4?

E, P, or I?

2024 #1 - Section 3

QuickNotes
1. Linkage + decision
2. Conclusion in context

Student response #1

With a p-value of 0.3576, we fail to reject H_0 and do not have convincing evidence of a difference in the proportion of people ages 18 to 55 years who would be interested in taking online fitness classes and the proportion of people ages 56 and older who would be interested in taking online fitness classes.

Component 1?

Component 2?

E, P, or I?

Student response #2

Because $0.3576 > 0.05$ we fail to reject H_0, and we have proved that there is no difference in the proportion of all exercise center members ages 18 to 55 years who would be interested in taking online fitness classes and the proportion of all exercise center members ages 56 and older who would be interested in taking online fitness classes.

Component 1?

Component 2?

E, P, or I?

Student response #3

Assuming H_0 is true ($p_1 = p_2$), there is a 0.3576 probability of getting a $\hat{p}_1 - \hat{p}_2$ value of -0.0435 or lower purely by chance. Because $0.3576 > 0.05$ we fail to reject H_0 and do not have convincing evidence of a difference in the proportion of all exercise center members ages 18 to 55 years who would be interested in taking online fitness classes and the proportion of all exercise center members ages 56 and older who would be interested in taking online fitness classes.

Component 1?

Component 2?

E, P, or I?