AP STATISTICS INFERENCE EXAM – STUDENT CREATED

Purpose:
The purpose of this exam is to review all of the confidence intervals and significance tests that students will need to know for the AP Exam.

Format:
The exam will be composed of four questions with each question being on its own page. The first two questions will ask students to create a confidence interval. The last two questions will ask students to perform a significance test. The context for each question should be unique. The exam should take around 60 minutes.

Grading:
The exam is worth 30 points total. Each confidence interval will be worth 6 points and each significance test will be worth 9 points.

Confidence Intervals (6 points each)
(1 point) STATE: parameter being estimated is identified (1/2 point) along with a specific confidence level (1/2 point)
(2 points) PLAN: Correctly identify the type of confidence interval (1/2 point), and then correctly check the three conditions (1/2 point each) with the → "so what?"
(2 points) DO: Correct general formula for a confidence interval (1/2 point), correct specific formula with variables (1/2 point), correct numbers substituted into the formula (1/2 point), and correct answer (1/2 point)
(1 point) CONCLUDE: The confidence interval is correctly interpreted in the context of the problem with appropriate units.

Significance Tests (9 points each)
(2 points) STATE: Parameter is identified (1/2 point), hypotheses are stated correctly (1 point), and the appropriate alpha level is given (1/2 point)
(2 points) PLAN: Correctly identify the type of significance test (1/2 point), and then correctly check the three conditions (1/2 point each) with the → "so what"
(3 points) DO: Correct general formula for a test statistic (1/2 point), correct specific formula with variables (1/2 point), correct numbers substituted into the formula (1/2 point), correct test statistic (1/2 point), and correct P-value (1/2 point). Also included is a picture of the sampling distribution (1/2 point).
(2 points) CONCLUDE: The conclusion is stated correctly and includes context.

Students will be responsible to create and grade these exams. Grading should be done in a fashion that is similar to the way the teacher grades exams. Your own grade on the exam will be affected by the quality of the exam you write.

Example question: Confidence Interval

Mr. Wilcox believes that his AP Stats students have a much better grasp of inference than the average AP Stats student. To test his idea, Mr. Wilcox randomly selects 7 of his students and gives them a standardized inference exam that is given to students nationally. Nationally, the exam scores follow an approximately normal distribution. The average score by the students sampled was 84.2% with a standard deviation of 7.2%.

Create and interpret a 95% confidence interval for the average exam score for all of Mr. Wilcox's AP Stats students.

STATE: μ = the true mean exam score for all of Mr. Wilcox's students.
We are trying to estimate μ at a 95% confidence level.

PLAN: ONE SAMPLE T-INTERVAL FOR MEAN

Check conditions

(1) Random : "randomly selects 7 of his students"
→ so we can generalize to the population

(2) 10% : 7 < 1/10 (94)
→ so sampling without replacement is OK.

(3) Normal : The population distribution is approximately normal
→ so the sampling distribution of $\bar{x}$ is approximately normal.

DO: Estimate $\pm$ Margin of Error

$$\bar{x} \pm t^* \frac{s}{\sqrt{n}} \text{ with df = 6}$$

$$84.2 \pm 2.447 \frac{7.2}{\sqrt{7}} = (77.5, 90.9)$$

CONCLUDE: We can be 95% confident that the interval from 77.5% and 90.9% captures the true mean exam scores for all of Mr. Wilcox's AP Stats students.

Example question: Significance Test

Mrs. Gallas believes that the proportion of students at East Kentwood High School (EKHS) that take a statistics class during their Senior year is higher than it was five years ago. She took a random sample of 150 EKHS Seniors from 2014 and found that 45 took a statistics class. A random sample of 120 EKHS Seniors from 2019 revealed that 60 took a statistics class.

Do the data provide convincing evidence that the proportion of EKHS Seniors that take a statistics class has increased over the past five years?

STATE: H$_o$: $p_1 - p_2 = 0$ $\quad$ $p_1 - p_2$ = true difference in proportion of EKHS Seniors that take a statistics class (2019 – 2014)

H$_a$: $p_1 - p_2 > 0$ $\quad$ $\alpha = 0.05$ $\quad$ $\hat{p}_1 - \hat{p}_2 = \frac{60}{120} - \frac{45}{150} = 0.50 - 0.30 = 0.20$

PLAN: TWO SAMPLE Z-TEST FOR DIFFERENCE OF PROPORTIONS

Check conditions

(1) Random : Two independent random samples
→ so we can generalize to both populations

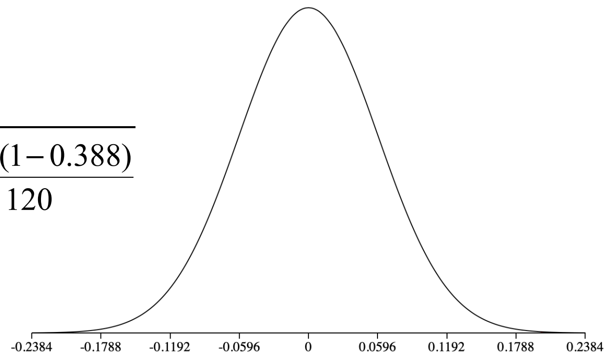
(2) Independent : 150 < 1/10 (2000+ students in 2014)
120 < 1/10 (2000+ students in 2019)
→ so sampling without replacement is OK.

(3) Normal: $n\hat{p}_1, n(1-\hat{p}_1), n\hat{p}_2, n(1-\hat{p}_2)$ = 60, 60, 45, 105 > 10
→ so the sampling distribution of $\hat{p}_1 - \hat{p}_2$ is approximately normal.

DO:

Test Statistic = $\frac{statistic - parameter}{std.dev\, statistic}$

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\hat{p}_c(1-\hat{p}_c)}{n_1} + \frac{\hat{p}_c(1-\hat{p}_c)}{n_2}}} \qquad z = \frac{(0.20) - (0)}{\sqrt{\frac{0.388(1-0.388)}{150} + \frac{0.388(1-0.388)}{120}}}$$



z = 3.35

P-value = 0.0004

CONCLUDE:

Assuming H$_o$ is true ($p_1 - p_2$ = 0), there is a .0004 probability of obtaining an $\hat{p}_1 - \hat{p}_2$ value of 0.20 or greater purely by chance. Because the P-value of 0.0004 < α = 0.05, we reject H$_o$ and we do have convincing evidence that the proportion of EKHS Seniors that take a statistics class has increased over the past five years.