"FRAPPY"

A bottle-filling machine is set to dispense 12.1 fluid ounces into juice bottles. To ensure that the machine is filling accurately, ever hour a worker randomly selects four bottles filled by the machine during the past hour and measures the contents. If there is convincing evidence that the mean amount of juice dispensed is different from 12.1 ounces or if there is convincing evidence that the standard deviation is greater than 0.05 ounce, the machine is shut down for recalibration. It can be assumed that the amount of juice that is dispensed into bottles is normally distributed. During one hour, the mean number of fluid ounces of four randomly selected bottles was 12.05 and the standard deviation was 0.085 ounce.

Scoring: Perform a test of significance to determine whether the mean amount of juice dispensed is different from 12.1 fluid ounces.

E   P   I

E   P   I

E   P   I

E   P   I

Total:___/4

Cardio Pump vs CPR

#1 2009 BQ3 — 2 Sample TOH for $P_1 - P_2$

(A) P_1 = Proportion of patients surviving w/ Cardio Pump

P_2 = Proportion of patients surviving w/ CPR

$$H_0: P_1 = P_2 \qquad \text{or} \qquad H_0: P_1 - P_2 = 0 \qquad \boxed{\alpha = .05}$$
$$H_A: P_1 > P_2 \qquad\qquad H_A: P_1 - P_2 > 0$$

(B) <u>2 Sample Z-Test for $P_1 - P_2$</u>

<u>Conditions</u>

Random — Treatments randomly assigned
by tossing a coin

Independent — Treatments are independent
because this is a well designed experiment

Normal —   Cardio Pump   vs   CPR
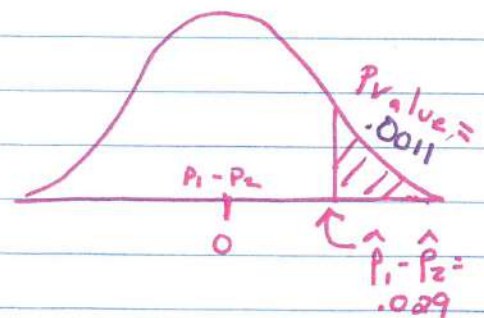 $37 \geq 10$ ✓ $15 \geq 10$ ✓
               $717 \geq 10$ ✓ $731 \geq 10$ ✓

(C) $\hat{P}_1 = .049 \qquad \hat{P}_2 = .020$
$n_1 = 754 \qquad\qquad n_2 = 746$

$\hat{P}_1 - \hat{P}_2 = .049 - .020 = .029$

$\hat{P}_c = \dfrac{37 + 15}{754 + 746} = .035$ [must use pooled $\hat{P}$]

$$Z = \frac{(.049 - .020) - 0}{\sqrt{(.035)(.965)\left(\frac{1}{754} + \frac{1}{746}\right)}} = 3.06$$ [get from calc]

$P(z \geq 3.06) = .0011$

P value = .0011

$P_1 - P_2$ 0 $\hat{P}_1 - \hat{P}_2 = .029$

2009 BQ3 (CONT)

(D) SINCE THE PVALUE (.0011) IS LESS THAN $\alpha = .05$, WE REJECT H_0.

WE HAVE CONVINCING EVIDENCE TO SUPPORT THE CONCLUSION THAT THE PROPORTION OF PATIENTS WHO SURVIVE WHEN TREATED WITH THE CARDIO PUMP IS HIGHER THAN THE PROPORTION OF PATIENTS WHO SURVIVE WHEN TREATED WITH CPR.

① Additional Questions For 2009 B Q3

QUESTIONS

(A) FOR YOUR TOH, CAN YOU COMPLETE A COMPRABLE CI?
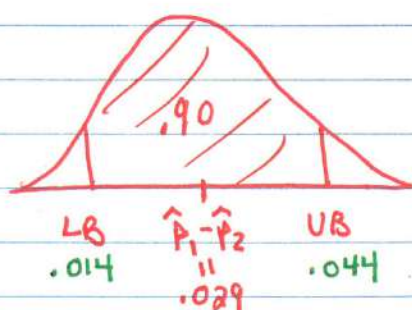
∴ NO, A CI can only be compared to a 2-TAIL TEST.

(B) CALCULATE AND INTERPRET THE DIFFERENCE OF PROPORTIONS.

∴ $\hat{P}_1 - \hat{P}_2 = .049 - .020 = .029$

IN REPEATED SAMPLES, THE PROPORTION OF PATIENTS SURVIVING TREATED WITH THE CARDIO PUMP IS 2.9% HIGHER THAN PATIENTS TREATED WITH CPR, IN THE LONG RUN

C+D USE CALC + ONLY SKETCH GRAPHS
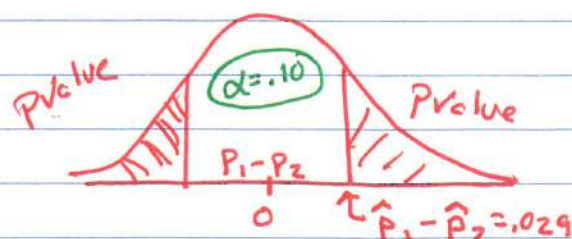

(C) USE CALC TO FIND A 90% CI:

LB $\hat{P}_1 - \hat{P}_2$ UB
.014   ॥   .044
           .029

DECISION:

Reject H_0, because zero is NOT IN CI

(D) USE CALC TO DO A 2-TAIL TOH:

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

$\alpha = .10$

Pvalue   Pvalue

$P_1 - P_2$
0

↑ $\hat{P}_1 - \hat{P}_2 = .029$

$Z = 3.066$ pvalue $= .0022$

DECISION:

Pvalue $< \alpha = .10$ Reject H_0

THESE ARE COMPARABLE

"FRAPPY"
{Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

Patients with heart-attack symptoms arrive at and emergency room either by ambulance or self-transportation provided by themselves, family, or friends. When a patient arrives at the emergency room, the time of arrival is recorded. The time when the patient's diagnostic treatment begins is also recorded.

An administrator of a large hospital wanted to determine whether the mean wait time (time between arrival and diagnostic treatment) for patients with heart-attack symptoms differs according to the mode of transportation. A random sample of 150 patients with heart-attack symptoms who had reported to the emergency room was selected. For each patient, the mode of transportation and wait time were recorded. Summary statistics for each mode of transportation are show in the table below.

Mode of Transportation	Sample Size	Mean Wait Time (in minutes)	Standard Deviation of Wait Times (in minutes)
Ambulance	77	6.04	4.30
Self	73	8.30	5.16

Scoring:

(a) Use a 99 percent confidence interval to estimate the difference between the mean wait times for ambulance-transported patients and self-transported patients at this emergency room.

E   I

E   I

E   I

(b) Based only on this confidence interval, do you think the difference in the mean wait times is statistically significant? Justify your answer.

E   I

Total:___/4

② 2006 Q4 — 2 SAMPLE T INTERVAL FOR $\mu_1 - \mu_2$ [PART A]

Ⓐ μ_A = mean wait time ARRIVING BY AMBULANCE
μ_S = mean wait time by self transportation

STATE: 2 SAMPLE t-INTERVAL FOR DIFFERENCE
OF MEANS.

CONDITIONS

Random — a random sample of 150 patients selected
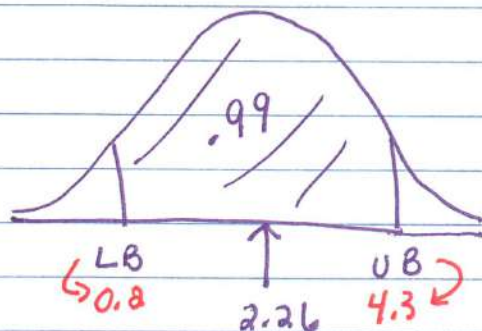INDEPENDENT — IT IS REASONABLE THERE ARE
MORE THAN 10(150) = 1,500 heart attack
PATIENTS TREATED BY THIS HOSPITAL
NORMAL — CLT APPLIES BECAUSE BOTH SAMPLES
WERE GREATER THAN 30 (n = 77, 73)

Ⓑ MECHANICS:

$\overline{X}_S - \overline{X}_A = 8.30 - 6.04 = 2.26$

$8.30 - 6.04 \pm t^* \sqrt{\dfrac{4.3^2}{77} + \dfrac{5.16^2}{73}}$

.99

LB ↱ 0.8   2.26   UB ↰ 4.3

TECHNOLOGY
POOLED | NO | [.229, 4.29]
                  df = 140.4

BY HAND: $t^* = 2.65$ df = 73 - 1 = 72   [.199, 4.32]
write formula above and replace t^*

Ⓒ WE ARE 99% Confident that the true mean wait time difference
between ambulance and self transportation is between
0.2 and 4.3 MINUTES.

THE CONFIDENCE INTERVAL PROVIDES
EVIDENCE THE WAIT TIME IS SIGNIFICANT
BECAUSE ZERO (0) IS NOT IN OUR 99% C.I.

WE WOULD REJECT H_0 AT THE $\alpha = .01$
FOR THE TEST OF HYPOTHESIS:

$$H_0: \mu_A = \mu_S$$
$$H_A: \mu_A \neq \mu_S$$

"FRAPPY"
{Free Response AP Problem...Yay!}

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A French study was conducted in the 1990s to compare the effectiveness of using an instrument called a cardiopump with the effectiveness of using traditional cardiopulmonary resuscitation (CPR) in saving lives of heart attack victims. Heart attack patients in participating cities were treated with either a cardiopump or CPR, depending on whether the individual's heart attack occurred on an even-numbered or an odd-numbered day of the month. Before the start of the study, a coin was tossed to determine which treatment, a cardiopump or CPR, was given on the even-numbered days. The other treatment was given on the odd-numbered days. In total, 754 patients were treated with a cardiopump, and 37 survived at least one year; while 746 patients were treated with CPR, and 15 survived at least one year.

Scoring:

(a) The conditions for inference are satisfied in the study. State the conditions and indicate how they are satisfied.

E   P   I

(b) Perform a statistical test to determine whether the survival rate for patients treated with a cardiopump is significantly higher than the survival rate for patients treated with CPR.

E   I

E   I

E   I

Total:___/4

"FRAPPY"

2009B Problem 5

The following problem is taken from an actual Advanced Placement Statistics Examination. Your task is to generate a complete, concise statistical response in 15 minutes. You will be graded based on the AP rubric and will earn a score of 0-4. After grading, keep this problem in your binder for your AP Exam preparation.

A bottle-filling machine is set to dispense 12.1 fluid ounces into juice bottles. To ensure that the machine is filling accurately, ever hour a worker randomly selects four bottles filled by the machine during the past hour and measures the contents. If there is convincing evidence that the mean amount of juice dispensed is different from 12.1 ounces or if there is convincing evidence that the standard deviation is greater than 0.05 ounce, the machine is shut down for recalibration. It can be assumed that the amount of juice that is dispensed into bottles is normally distributed. During one hour, the mean number of fluid ounces of four randomly selected bottles was 12.05 and the standard deviation was 0.085 ounce.

Scoring: Perform a test of significance to determine whether the mean amount of juice dispensed is different from 12.1 fluid ounces.

① E P I

① μ = true mean number of ounces in all juice bottles filled in the past Hour

$H_0: \mu = 12.1$ $\alpha = .05$
$H_A: \mu \neq 12.1$

② E P I

② TEST: 1 Sample t-test for means (OR μ)

Conditions:

Random: 4 bottles were randomly selected this hour

Independent: It is reasonable more than $4(10)=$ 40 bottles filled each hour.

③ E P I

NORMAL: assumed bottle filling is normally distributed
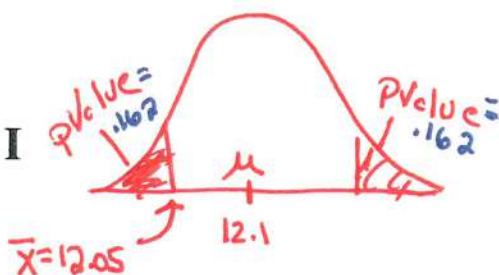
③ MECHANICS

$n=4 \longrightarrow \boxed{df=3}$

$\bar{X} = 12.05$
$S_x = 0.085$

$t = \dfrac{12.05 - 12.1}{.085/\sqrt{4}} = -1.176$

$PVALUE = 2 \cdot P(t \leq -1.176) = .324$

④ E P I
ON Back

Pvalue= .162

Pvalue= .162

$\bar{X}=12.05$ 12.1

Total:___/4

(4)

Since the pvalue (.324) is GREATER THAN $\alpha=.05$, we fail to reject Ho.

There is not sufficient evidence to conclude the machine is filling the bottle with the 12.1 fluid ounces set by the machine.