# *Hypothesis Testing*

Q.(1) The dean from UCLA is concerned that student's grade point averages have changed dramatically in recent years. The graduating senior's mean GPA over the 5 year is 2.75. The dean randomly samples 256 seniors from last graduating class and finds that their mean GPA is 2.85 with a sample std of 0.65

(a) what would the null & Alternate Hypothesis for this scenario?

Ans → SE (Sample ~~std error~~) ~~is not~~ gi

$H_0$ = GPA did not changed dramatially over the year

$H_1$ = GPA change dramatically over the time

(b) What would be the standard Error for this scenario.

Ans ⇒ ~~SE = 0.65~~

$\sigma_p \hat{=} \sigma_s$ Hence $\sigma_p = 0.65$

(c) Describe critical Regions for $\alpha = 0.05$

Ans ⇒ Since secnario asked GPA has changed (it can be decreased or increase) so two tailed test

$CI = 95\%$

$\alpha = 0.05 = 5\%$

1d) Test the null hypothesis & explain your decision

$N = 256$

$$Z_s = \frac{\cancel{\bar{x}-\mu_s}\ \mu_s - \mu_{pop}}{\sigma_p}$$

$$= \frac{2.85 - 2.75}{\frac{0.65}{\sqrt{N}}}$$

$$Z_s = \frac{2.85 - 2.75}{\frac{0.65}{\sqrt{256}}} = 2.46$$

$$\boxed{Z_s = 2.46}$$

Reject Null Hypothesis as it falls under critical region. CR is reject region.

Hence, GPA has not been changed dramatically over the years.

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(2) The College bookstore tells prospective student that average cost of its textbook is Rs. 52 with std dev of ~~Rs~~ 4.50 Ruppees. A group of small statistics students think that the average cost is higher. To test the bookstore's claim against their alternative, the student will select a random sample of size 100. Assume that the mean from their sample is 52.80. Perform a hypothesis test at the 5% CI & state your decision.

Ans: $\mu_{pop} = 52$, $\mu_s = 52.80$, $\sigma_{pop} = 4.50$, $N = 100$

Hypothesis

$H_0$ = Average cost is not higher

$H_1$ = Average cost is ~~no~~ Higher

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$$Z = \frac{\mu_S - \mu_{pop}}{\frac{\sigma_{pop}}{\sqrt{N}}}$$

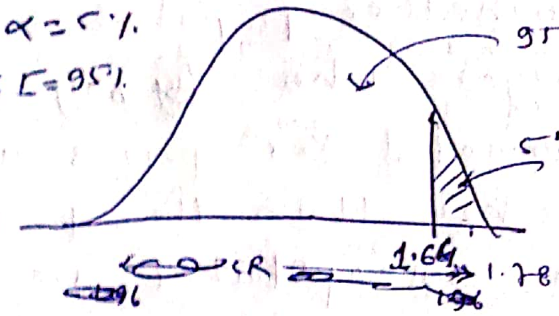
$$= \frac{52.6 - 52}{\frac{4.50}{\sqrt{100}}}$$

$$\boxed{Z = 1.78}$$

Since students are saying its higher then a right tailed test

$\alpha = 5\%$

$CL = 95\%$




Since $1.78 > 1.64$ Reject Null Hypothesis

Average cost is higher.

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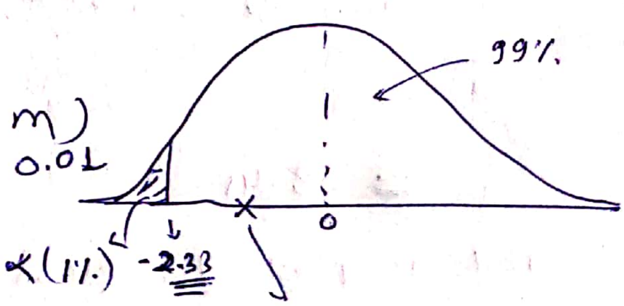
(3) A certain chemical pollutant in the river has been constant for several years with a mean of 34ppm and standard deviation of 8 ppm. A group of factory representative whose companies discharg liquids into the river is now claiming that they have lowered the average with improved fiteration devices. A group of environmentalists will test to see if this true at the 1% level of significance. Assume that their sample of size 50 gives a mean of 32.5 ppm. Perform a Hypothesis test at 1% SL.

0.99

Ans → $H_0 : \bar{X} = 34$ ppm

$H_A : \bar{X} < 34$ ppm (Claim)




$$Z_s = \frac{32.5 - 34}{\frac{8}{\sqrt{50}}}$$

$$= -1.33$$

Accept Null Hypothesis ($H_0$).

Company's claim is not accurate.

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(4) Carry out one tailed test to determine whether population proportion of traveli's check buyers who ~~By~~ buy atleast \$2500 in check when sweepstakes prizes are offered as at least 10% higher than the proportion of such buyers when no sweepstakes are on.

Population 1 : With sweepstakes

$N1 = 300$, $X1 = 120$, $S1 = 0.53$

Population 2 : No sweepstakes

$N2 = 700$, $X2 = 140$, $S2 = 0.20$

Ans

$H_0 : P_1 - P_2 \leq 0.10$

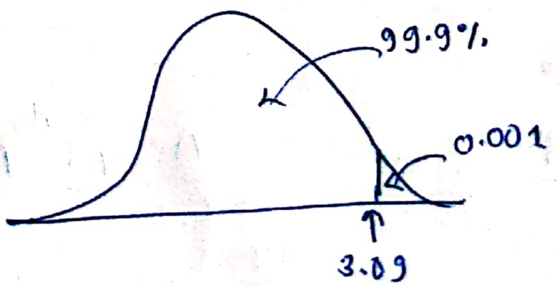
$H_A : P_1 - P_2 > 0.10$

$$z = \frac{(S_1 - S_2) - D}{\sqrt{\frac{P_1(1-P_1)}{n_1} + \frac{P_2(1-P_2)}{n_2}}}$$

$$= \frac{(0.53 - 0.20) - 0.10}{\sqrt{\frac{(0.53)(1-0.53)}{300} + \frac{0.20(0.80)}{700}}} = \frac{0.23}{4.96} \times \sqrt{e8}$$

$= 3.45$

Not accepted for even 0.01%, i.e 0.001 alpha




zcr

Zvalue of area(.9990)

$= 3.09$

Reject Null Hypothesis

(7) The school nurse thinks the avg height of 7th graders has increased. The avg height of a 7th grader five years ago was 145 cm with a std deviation of 20cm. She takes a random sample of 200 students & finds that avg height of her sample is 147 cm. Are 7th graders now taller than they before? Conduct a single-tailed hypothesis ~~this~~ test using a 0.05 significance level to evaluate the null & alternative hypothesis.

Ans

$H_0$ = Height of 7th grades ~~has increase~~ $\leq 145$

$H_1$ = Height of 7th grade has ~~not~~ increased $> 145$

$\sigma_{pop} = 20$, $N = 200$, $\alpha = 0.05 = 5\%$

$\mu_s = 147$, $\mu_{pop} = 145$

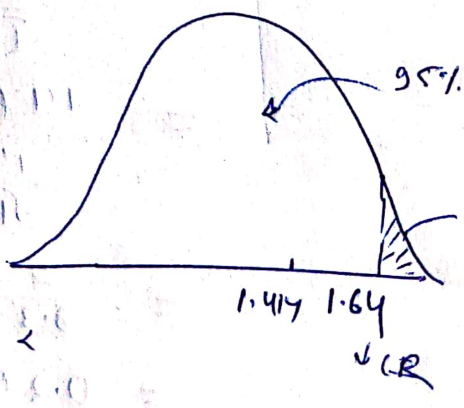
Testing the Hypothesis

$$Z_s = \frac{\mu_s - \mu_{pop}}{\sigma_p / \sqrt{N}}$$

$$= \frac{\mu_s - \mu_{pop}}{\sigma_p / \sqrt{N}}$$

$$= \frac{147 - 145}{\frac{20}{\sqrt{200}}}$$

$$= 1.414$$




Accept NULL Hypothesis

18) A Farmer is trying out a planting technique that he hopes will increase the yield on his pea plants. The average no. of pods on one of his pea plants is 145 pods with a std of 100 pods. This year, after trying his new planting technique, he takes a random sample of 144 of his plants and finds the avg no. of pods to be 147. He wonders whether or not this is a statistically increase. What are his hypothesis and test statistic?

⇒

$H_0 : \mu = 145$

$H_1 : \mu > 145$

$\sigma = 100$, $\mu_s = 147$, $\mu_{pop} = 145$

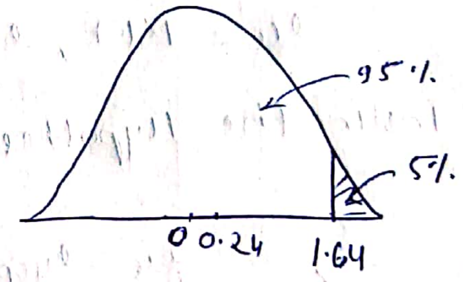
$N = 144$

$$Z_s = \frac{\mu_s - \mu_{pop}}{\frac{\sigma}{\sqrt{N}}}$$

$$= \frac{147 - 145}{\frac{100}{\sqrt{144}}}$$

$$= \frac{2}{8.3}$$

$$= 0.2409$$




Accept the $H_0$

So ~~mean~~ yield on farmer's pea plant has not increased

(9) You have just taken owenership of pizza shop. The previous owner told you that you would save money if you bought the mozzarella cheese in a 4.5 pound slab. Each time you purchase a slab of cheese, you weigh to ensure that you are recieving 72 ounces of cheese. The result of 7 random measurments are 70, 69, 73, 68, 71, 69 & 71 ounces. Are these diff$^n$ due to chance or is the distributor giving you less cheese you deserve.

(a) State the Hypothesis

Ans ⇒ $H_0$ = mean weight of cheese $= \mu = 72$

$H_1$: mean weight of chees $= \mu \neq 72$

(b) Calculate the test statistic

mean of sample $\mu = 70.143$

$s = 1.676$

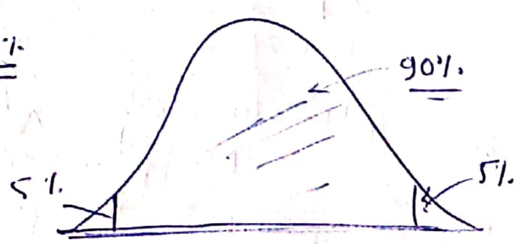
$$\boxed{\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i-\mu)^2}}$$

$$t = \frac{\bar{x}-\mu}{s/\sqrt{N}}$$

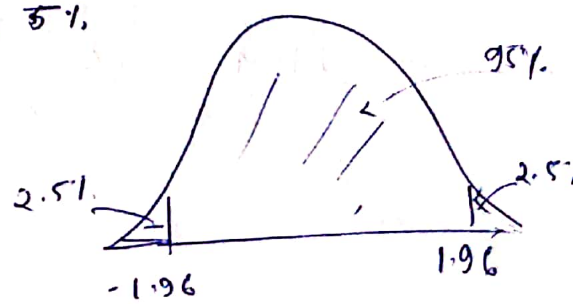
$$= \frac{70.143-72}{\frac{1.676}{\sqrt{7}}}$$

$$\boxed{t \approx -2.9315}$$

1) 10%




2) 5%




Reject Null in 5%, 10% conf level

3) 1%