Date: 11/9/23.

Q1 In the Population, the average IQ is 100 with a standard deviation of 15. A Team of scientists want to test a new medication to see If It has either a positive or negative effect on Intelligence or not effect at all. a sample of 30 participants who have taken the medication has a mean of 140. Did the medication affect Intelligence?

Ans- Given that Average IQ (μ) = 100.

Standard deviation (STD) = 15

Sample size (n) = 30

mean of the sample = 140.

α = 5 %. (taken).

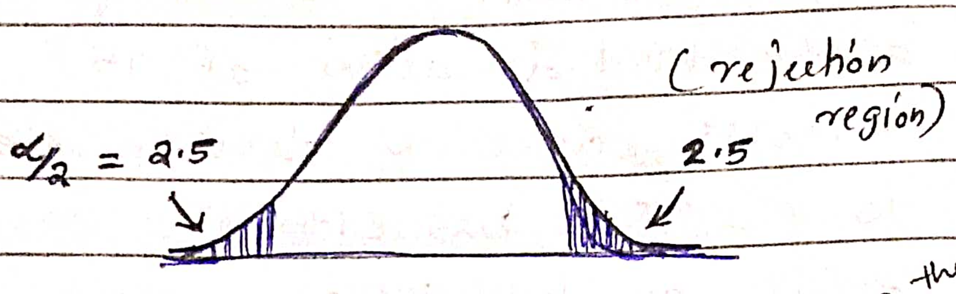
Ho — $\mu = 100$ (medication is +ve or -ve effect on IQ)

Ha — $\mu \neq 100$. (medication does not effect IQ)

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$

$$= \frac{140 - 100}{15/\sqrt{30}} = \frac{40}{15/\sqrt{30}} = \underline{\underline{14.605}}$$

$H_a \rightarrow \mu \neq \mu_0$.



It lies on the RR.

z value is more so it, we reject the null hypothesis (H_0)

$\therefore$ medication doesn't affect IQ

Q2. A car manufacturer claims that the average fuel efficiency of it's new model is 30 miles per gallon, To test this claim, a random sample of 35 cars is selected and their average fuel efficiency is found to be 29.2 with a standard deviation of 2.5 z-test at a 5% significance level to determine if the manufacturer's claim is supported.

Ans - $\alpha = 5\%$

Std dev $= 2.5$

$n = 35$

$\mu = 30$

$H_0 \rightarrow \mu = 30$ (the Avrg fuel efficiency is 30 miles)

$H_a \rightarrow \mu \neq 30$ (the Avrg fuel efficiency of new model is not equal to 30)

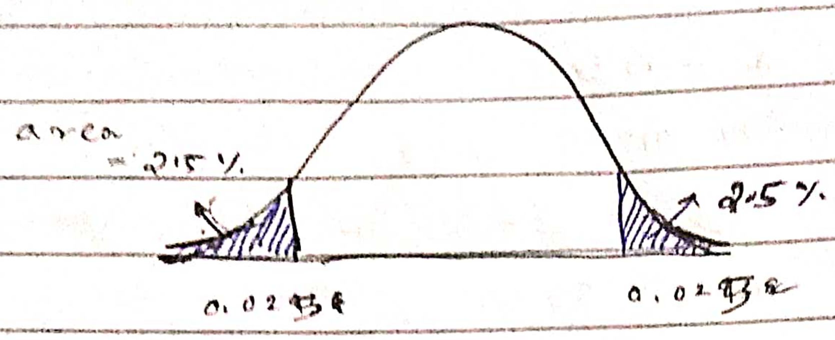
$$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{29.2 - 30}{\frac{2.5}{\sqrt{35}}}$$

$$= \frac{-0.8}{\frac{2.5}{\sqrt{35}}} = \frac{-0.8}{0.422} = -1.896$$

$\therefore$ Standard normal distribution

(Values represent area to the Left & right of the Z-score)

$= 0.02938$



z score is lies between the ~~stand~~ ~~acceptance region~~. rejection region
ie, the acceptance region.
So. we can conclude that the the car manufacturer claim was. ~~wa~~ true.
ie, the fuel efficiency is 30 miles.

Q3. A company claim that their new marketing Campaign will Increase website traffic by at least 20%. before the Campaign the Avg daily website traffic was 2000 Visitors. After the Campaign, a random Sample of 30 days shows an AVrg daily traffic of 2100 visitors with a standard deviation of 150 visitors. Perform a One-sample z-test at a 5% S.L to determine if the claim is supported.

given that

Ans - $\alpha = 5\%$

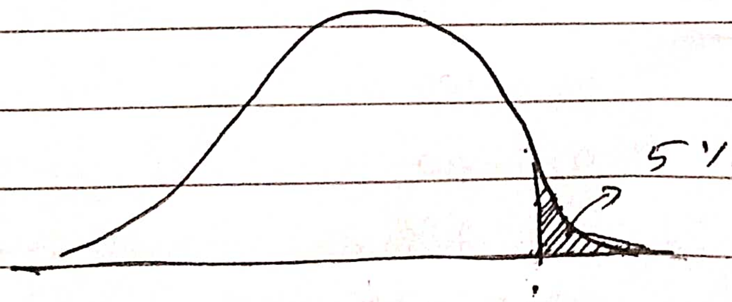
$S.D = 150$

$\mu = 2000.$

$H_0 \rightarrow \mu \leq 2000$ (website traffic is increased by less than or ~~atleast~~ equal 20%.)

$H_a \rightarrow \mu > 2000$ (web traffic is ~~atleast 20%~~ increased ~~by atleast 20%~~ by a new campaign.

$$z = \frac{2100 - 2000}{\frac{150}{\sqrt{30}}} = \frac{100}{\frac{150}{\sqrt{30}}} = 3.651$$



Z Table value $\rightarrow$ 0.99986.

~~Probability~~ $= 1 - 0.99987$

$= 0.00013$

It is very small value. ~~P is less than~~

~~and also is less than 5% (0.05)~~

we reject the H_0. so, the new marketing campaign. ~~web traffic~~ Increased web traffic. ~~by at least 20%.~~

Q4 A researcher want to test if the Average IQ score of a group of students is different from the national avrg IQ Score of 100. A random Sample of 40 student is taken, their Avg IQ score is 102 with a S.D of 15. perform a 1-sample z-test at a 1% S.L to determine If the group's Avrg IQ Score is significantly different from the national average.

Ans.

$\mu = 100$.

$n = 40$

$\alpha = 1\%$.

$S.D = 15$

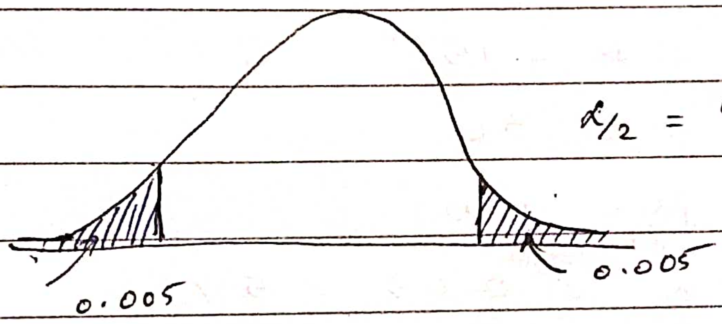
$$z = \frac{102 - 100}{15/\sqrt{40}} = \frac{2}{15/\sqrt{40}}$$

$$= \underline{0.843}$$

$H_0 \rightarrow \mu = 100$. (Student IQ = National IQ)

$H_a \rightarrow \mu \neq 100$. (Studen IQ ≠ National IQ)
It's different

$z = 0.843$.



$\alpha/2 = \frac{0.01}{2} = 0.005$

z table vale — 0.79955

= ~~[illegible]~~ = ~~[illegible]~~

It is lies in the acceptane region.
so the null hypothesis is supported.
the student group Avg IQ score is.
equal to the national Avg IQ score.

Q5. You know that the standard deviation of IQ in the general population is 15 you test your drug on 36. patients and obtain a mean IQ of 97.65 using an $\alpha = 0.05$ ~~[illegible]~~ is this IQ significantly different than the population mean of 100?

Ans-

$S.D = 15$

$n = 36.$

$M_{pop} = 100$

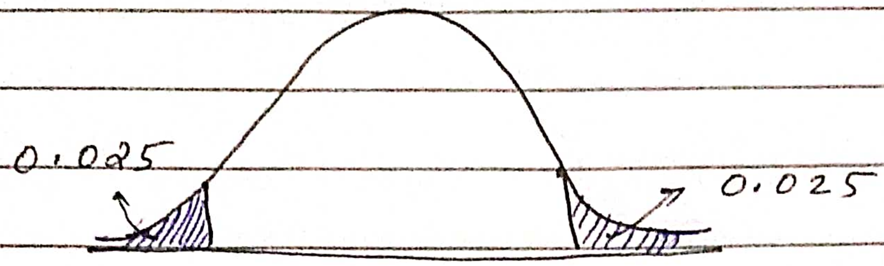
$\alpha = 0.05 = 5\%.$

$H_0 \rightarrow M = 100$ (If drug use there is no significant effect on IQ)

$H_a \rightarrow M \neq 100.$ (drug has significant effect or difference on IQ)

$$Z = \frac{97.65 - 100}{15/\sqrt{36}} = \frac{-2.35}{15/6}$$

$$= -0.94$$



Z - table value $-$ 0.17361 - std N.D

It is lies in the acceptance region. So the drugs has no significant effect on IQ.

Q2 Critical Method

$Z_{calculate} = -1.896.$

$Z_{critical} = \pm 1.96$

$Z_{calculate} < Z_{critical} \Rightarrow$ accept H_0:

P-value Method

$P_{value} = 1 - 0.02938$

$= 0.97062$

$P_{value} > \alpha$ value $\Rightarrow \therefore$ fail to reject.

Q3 Critical method

$Z_{cal} = 3.651$

$Z_{crt} = \cancel{0.9} \pm 1.65$

$Z_{cal} > Z_{crt} \Rightarrow$ Reject Ho.

P-value method

$P_{value} = 1 - 0.99987$
$= 0.00013 \Rightarrow$ Reject Ho.

$P_{value} < \alpha$ value $\Rightarrow$ very small value.

Q4 Critical method

$Z_{cal} = 0.843$

$Z_{crt} = 0.79955$

$Z_{cal} \geq Z_{crt}$ ~~hence reject Ho~~
lies in acceptance ~~region~~. Ho

P value = 0.2.

Q5 $Z_{cal} = -0.94$

$Z_{crt} = \pm 1.96$.

$Z_{cal} < Z_{crt} \Rightarrow$ accept H_0.

Pvalue $= 1 - 0.17361$

$= 0.826$.

Pvalue $> \alpha$ value. $\Rightarrow$ accept H_0.