[5 marks]

Date: / /

~~Reject~~

Type 1 & Type 2 Error

Null Hypothesis (H_0) = coin is fair
Alternate " (H_1) = coin is not fair

→ Outcome 1: We reject the Null hypothesis, when reality it is false → Yes Good decision

→ Outcome 2: We reject the Null hypothesis, when ~~in reality~~ reality, it is True → $\boxed{\text{Type 1 Error}}$

→ Outcome 3: We accept the Null hypothesis, when in reality is is ~~true~~ ~~false~~ false → $\boxed{\text{Type 2 Error}}$

→ Outcome 4: We accept the Null hypothesis, when in reality it is true → Good

Predicted

Actual	P	N
T	TP	FP ~~FN~~
F	~~FP~~ FN	~~TN~~ TN

OK	Type 2 Error
Type 1 Error	OK

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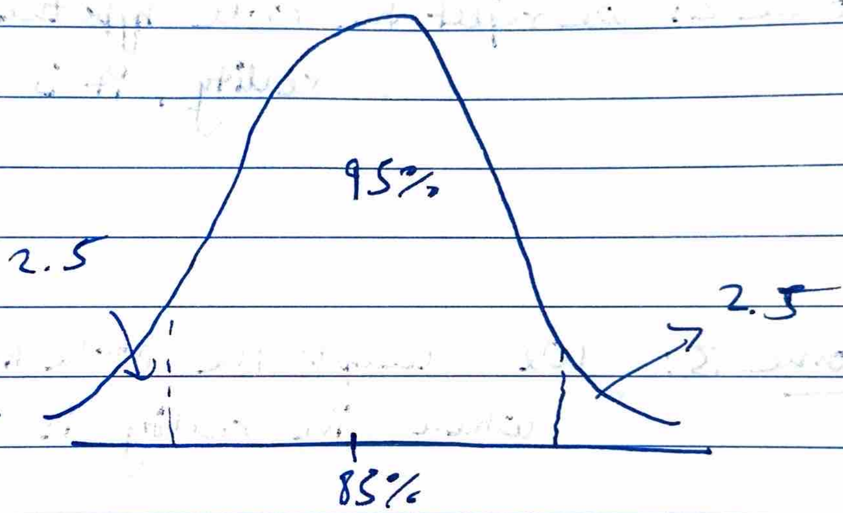
1 Tail & 2 Tail test

Eg Colleges in Karnataka have a 85% placement rate. A new college was recently opened & it was found that the sample of 150 student had a placement rate of 88% with the SD 4%. Does this college ~~have~~ ~~had~~ has the different placement rate?

Let $\alpha = 0.05$

$\boxed{\text{2 tailed test}}$

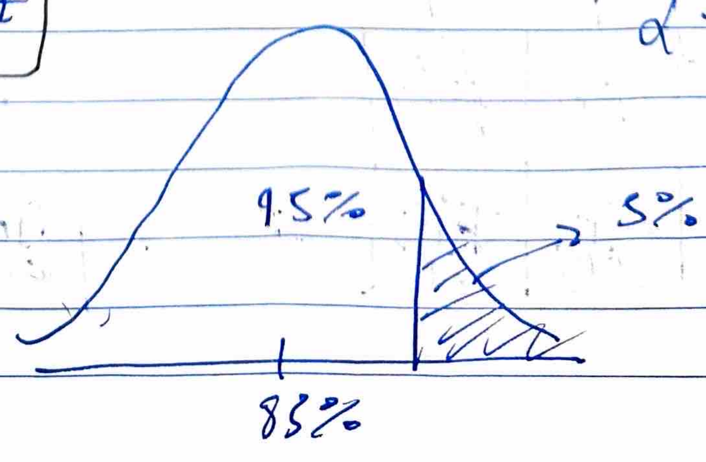


Let suppose

$\Rightarrow$ Does the college have placement rate greater than 85%?

$\boxed{\text{1 tailed test}}$

$\alpha = 0.05$



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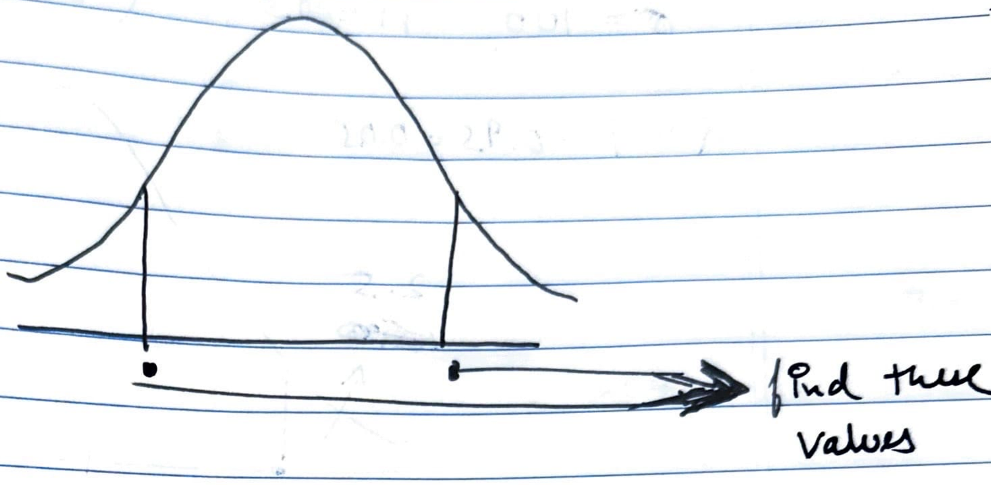
Q How to find the Confidence Intervals ?



Point Estimates → The value of any statistic that estimates the value of a parameter

Sample → Population
Estimate.
$\bar{x}$ μ

Confidence Intervals

$\boxed{\text{Point Estimate} \pm \text{Margin of Error}}$

Q On the Quant test of CAT Exam, the standard deviation is known to be 100. A sample of 25 test takes has the mean of 520 score. Construct a 95% CI about the mean?

Margin of Error → how many percentage points your results will differ from the real population value

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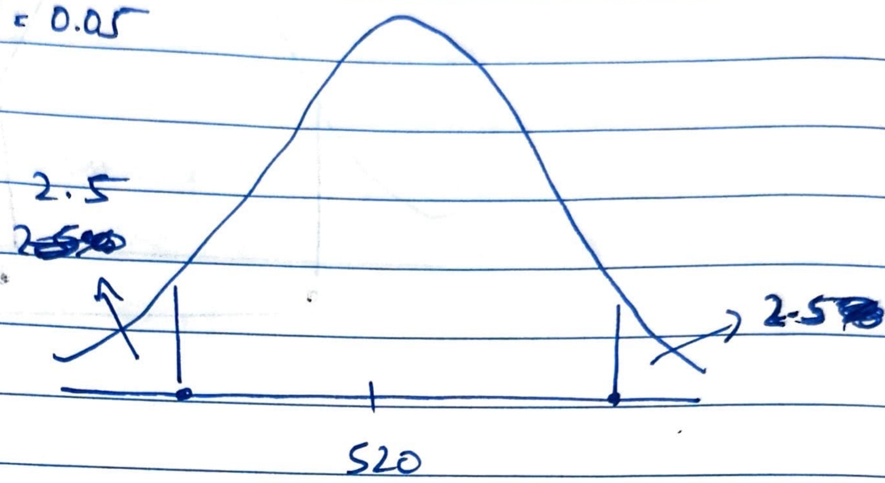
$\sigma = 100$, $n = 25$ $\alpha = 0.05$ $\bar{x} = 520$

$\alpha = 1 - 0.95 = 0.05$



→ when $\boxed{\text{population sd}}$ is given we apply z test

Point Estimate ± Margin of Error

$$\boxed{\bar{x} \pm z_{\alpha/2} \boxed{\frac{\sigma}{\sqrt{n}}}} \rightarrow \text{Standard Error}$$

Note - z test should be apply when -

① Population SD is given

② $n \geq 30$ $n \rightarrow$ sample size

z test → z score

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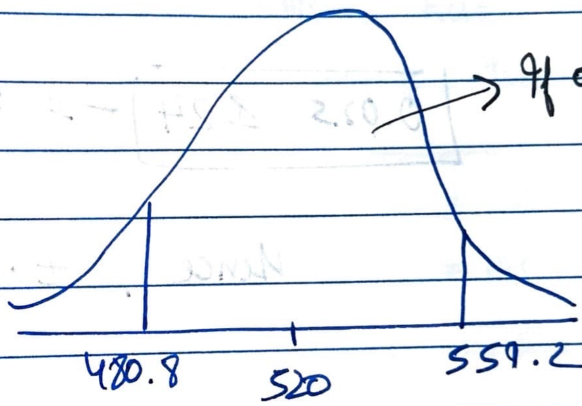
Upper Bound $= \bar{x} + Z_{\frac{0.05}{2}} \frac{100}{\sqrt{25}}$ $Z_{\frac{0.05}{2}} = Z_{0.025}$

Lower Bound $= \bar{x} - Z_{\frac{0.05}{2}} \frac{100}{\sqrt{25}}$ $1 - 0.025$
$= 0.975$
$= \boxed{1.96}$ → z table

Upper $= 520 + 1.96(20) = 559.2$
Lower $= 520 - 1.96(20) = 480.8$



If our value falls in between this NULL Hypothesis should be accepted.

→ ~~with~~ When $\boxed{\text{Population SD}}$ is not given, but $\boxed{\text{Sample SD}}$ given

$\bar{x} = 520$ $S = 80$ $n = 25$
$\alpha = 0.05$

→ $\boxed{\text{T- test should be used}}$

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Point Estimate $\pm$ Margin of Error

$$\bar{x} \pm t_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right) \rightarrow \text{Standard Error}$$

$$\boxed{UB = \bar{x} + t_{\frac{0.05}{2}}\left(\frac{s}{\sqrt{n}}\right)}$$

$t_{\frac{0.05}{2}} = \boxed{t_{0.025}}$ → t-table look

$\boxed{\text{Degree of freedom}} = n-1 = 25-1 = \underline{24}$

$\boxed{0.025 \; \& \; 24}$ → Look t-table

Hence, $t_{\frac{0.05}{2}} = \underline{2.064}$

$$UB = 520 + 2.064\left(\frac{80}{5}\right)$$

$$= 553.024$$

$$LB = 520 - 2.064\left(\frac{80}{5}\right)$$

$$= 486.97$$

$$[486.97 \longleftrightarrow 553.024]$$

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One Sample z- test

-> σ is given

-> ~~Sa~~ $n \geq 30$

Q In the population, average IQ is 100 with a SD of 15. Researchers wants to test a new medication to see if there is positive ~~of~~ or negative effect on intelligence, or no effect at all. A Sample of 30 participants who have taken the medication has a mean of 140. Did the medication alter the intelligence?

$\alpha = 0.05$

Ans

$n = 30$ $\quad$ $\sigma = 15$

$\bar{x} = 140$ $\quad$ $\mu = 100$

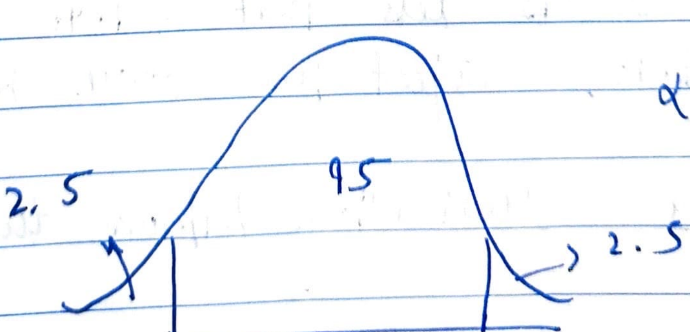
Define Null Hypothesis

$H_0 = \mu = 100$

" Alternate Hypothesis

$H_1 = \mu \neq 100$

$\alpha = 0.05$



2-tail test

$z_{\frac{0.05}{2}} = z_{0.025}$

$1 - 0.025 = 0.975$

$= \boxed{1.96}$

$UB = \bar{x} + z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$

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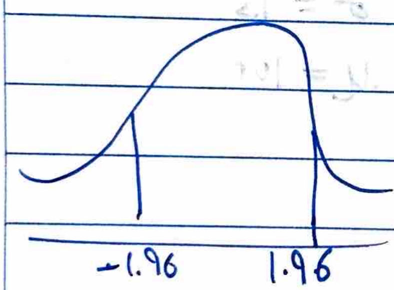
$$UB = 140 + 1.96\left(\frac{15}{\sqrt{30}}\right) = 145.36$$

$$LB = 140 - 1.96\left(\frac{15}{\sqrt{30}}\right)$$

Calculate Test Statistics

For only Sample data

$$z = \frac{\bar{x} - \mu}{\left(\frac{\sigma}{\sqrt{n}}\right)}$$



$$= \frac{140 - 100}{\frac{15}{\sqrt{30}}} = \frac{40}{15} \times \sqrt{30} = \underline{\underline{14.60}}$$

$14.60 > 1.96$

If z is less that -1.96 or greater than 1.96, reject the null hypothesis.

Ans Medication Improve the intelligence.

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One Sample T-test

t - test ⇒ unknown population SD

Q Same ~~prop~~ problem

Ans

$\mu = 100$

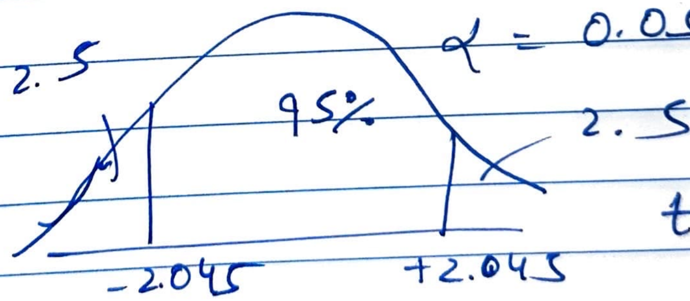
$n = 30$, $\bar{x} = 140$, $s = 20$

Did the medication affect intelligence?

$H_0 = \mu = 100$

H_1 $\mu \neq 100$

DOF = $n - 1 = 30 - 1 = 29$



$\alpha = 0.05$

$t_{\frac{\alpha}{2}} = t_{0.025}$

$\boxed{0.025 \ \& \ 29}$ → Look t-table

T test

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{140 - 100}{\frac{20}{\sqrt{30}}} = \frac{\cancel{40}^{2}}{\cancel{20}} \times \sqrt{30}$$

$$= 10.96$$

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$t = 10.96 > 2.045$

Reject the Null hypothesis

$\boxed{P \leq \text{Significance Value}}$