

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 (σ) = 15

Sample size (n) = 30

mean of the sample = 140.

$\alpha = 5\%$ (taken).

H_0 - $\mu = 100$ (medication is +ve or -ve effect on IQ)

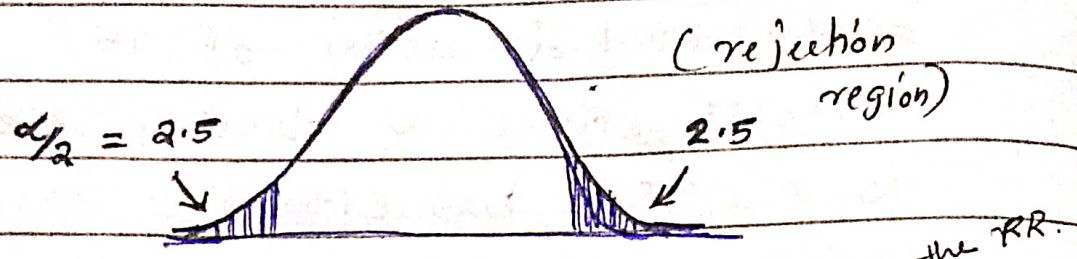
H_a - $\mu \neq 100$. (medication does not effect IQ)

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

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

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



z Value is more so \uparrow , we reject the null hypothesis (H_0)

\therefore medication does n't affect IQ

Q2. A car manufacturer claims that the average fuel efficiency of its 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 -

$$\alpha = 5\%$$

$$\text{Std. dev} = 2.5$$

$$n = 35$$

$$\mu = 30$$

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

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

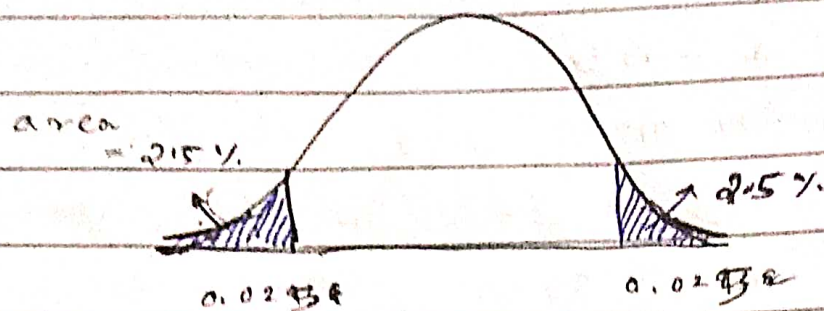
$$Z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}} = \frac{29.2 - 30}{\frac{2.5}{\sqrt{35}}}$$

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

\therefore standard normal distribution

(Values represent area to the left & right of the z-score)

$$= \underline{\underline{0.02938}}$$



Z score 1.5 lies between the ~~stand~~
~~acceptance~~ region. rejection region
 i.e., the acceptance region.

So, we can conclude that the
 the car manufacturer claim was
 true.

i.e., 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 Avg 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 ~~at least~~ ^{less than or} equal 20%.) or $\mu \leq$

$H_a \rightarrow \mu > 2000$ (web traffic is increased ~~by at least 20%~~ ^{by a new company}.)

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

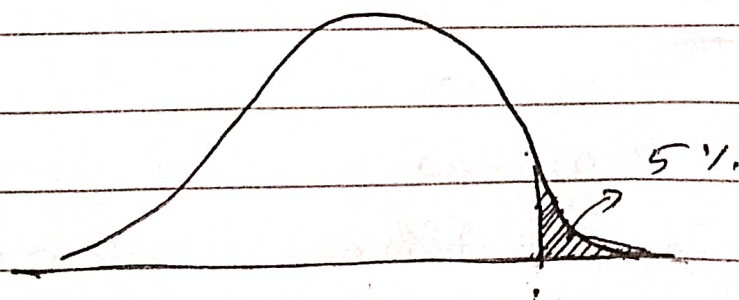


Table value $\rightarrow 0.99986$

$$\begin{aligned} \text{Probability} &= 1 - 0.99986 \\ &= 0.00014 \\ &= \end{aligned}$$

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

and also ~~is less than 5%~~ (cross)
we reject the H_0 . so, the new
marketing Campaign ~~web traffic~~ increases
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 avg 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 Avg IQ score is significantly
different from the national average.

Ans.

$$\mu = 100$$

$$n = 40$$

$$\alpha = 1\%$$

$$S.D = 15$$

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

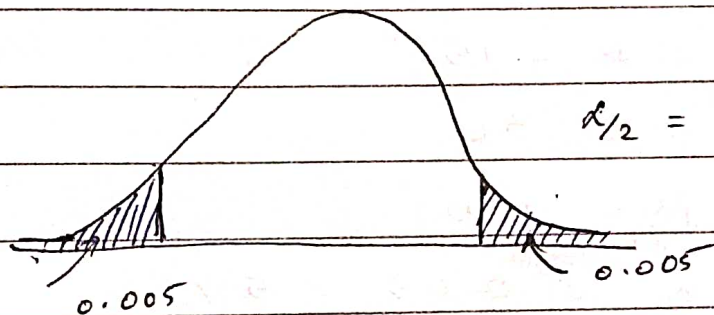
$$= \underline{\underline{0.843}}$$

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

$H_a \rightarrow \mu \neq 100$ (Student IQ \neq National IQ)
It's different

$$Z = 0.843$$



Z table value — 0.79955

$$= \cancel{0.79955} = \cancel{0.79955}$$

It lies in the acceptance region.
So the null hypothesis is supported.
The student group Avg IQ score is
equal to the national Avg IQ score.

Qs. 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 $\alpha = 0.05$ (5%) is this IQ significantly different than the population mean of 100?

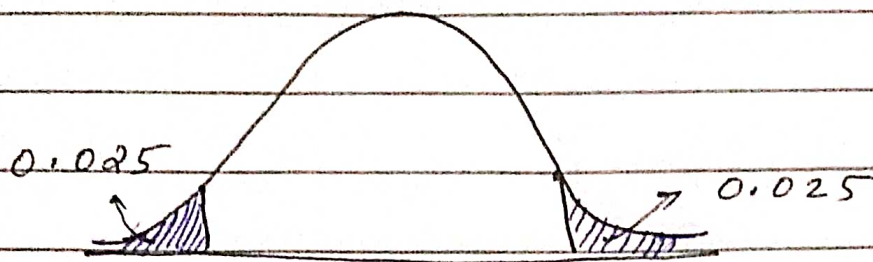
Ans- $S.D = 15$
 $n = 36$
 $\mu_{pop} = 100$
 $\alpha = 0.05 = 5\%$

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

$H_a \rightarrow \mu \neq 100$ (Drug has significant effect or difference on IQ)

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

$$= -0.94$$



Z - table value — 0.17361 — std N.D.

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