1, In the population, the average IQ is 100 with 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 effect intelligence?

Ans ⇒

$H_0 \rightarrow \mu = 100$

$H_1 \rightarrow \mu \neq 100$

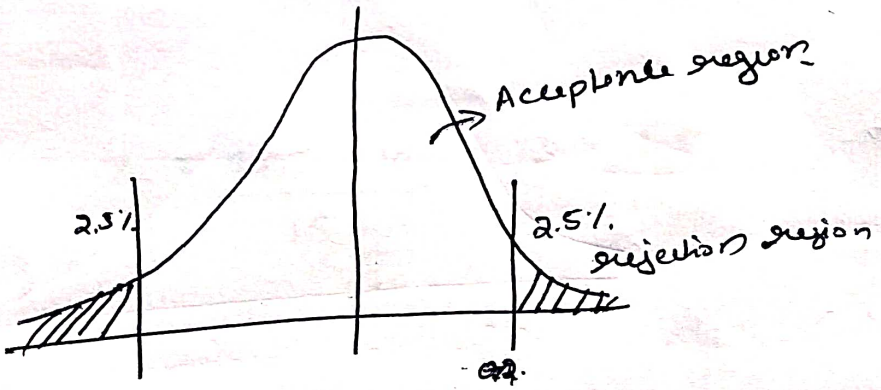
$\sigma = 15, \quad \alpha = 5\%$

$n = 30$

$\bar{x} = 140$

Z-test,

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{140 - 100}{15/\sqrt{30}} = 14.6$$



It lies in the rejection region. we can reject the null hypothesis. ie, the medication has positive effect on in intelligence.

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

Ans,

$H_0 \rightarrow M = 30$ mpg.

$H_1 \rightarrow M \neq 30$ mpg.

$\sigma = 2.5$,

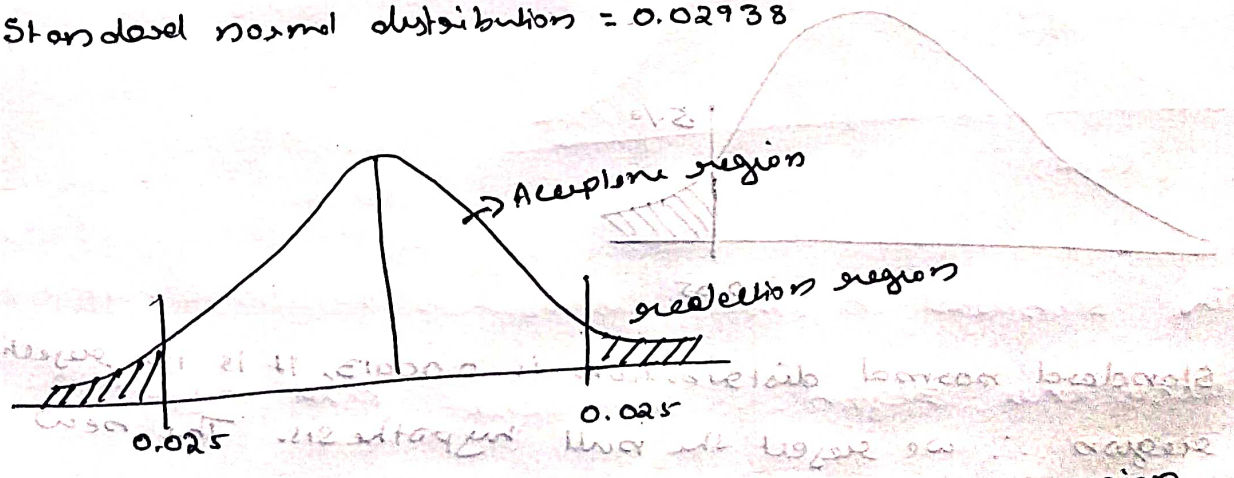
$\bar{x} = 29.2$

$\alpha = 5\%$, $n = 35$

Z-test,

$$Z = \frac{\bar{x} - M}{\sigma/\sqrt{n}} = \frac{29.2 - 30}{2.5/\sqrt{35}} = -1.89$$

Standard normal distribution = 0.02938



The standard normal distribution lies in Acceptance region.

ie, the company claim of the company is valid.

3. A company claims that their new marketing campaign will increase website traffic by at least 20%. Before the campaign, the average daily traffic of 2000 visitors, ~~with a standard deviation of 150 visitors, performs~~ a After the campaign, a random sample of 30 days shows an average daily traffic of 2100 visitors with a standard deviation 150 visitors. perform a one sample Z-test at a 5% significance level to determine if the claim is supported.

Ans:

$H_0 \rightarrow \mu <= 2000$

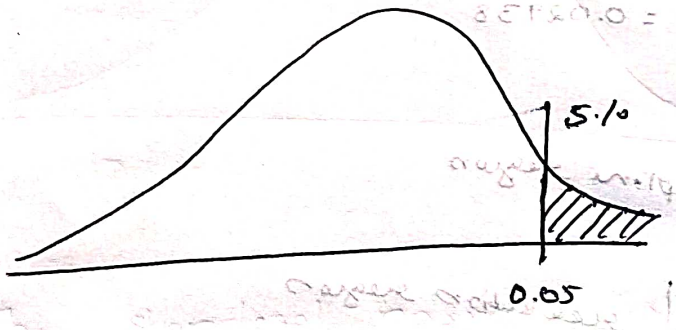
$H_1 \rightarrow \mu > 2000$

$\sigma = 150, \quad \alpha = 5\%$

$\bar{x} = 2100, \quad n = 30$

Z-test

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{2100 - 2000}{150/\sqrt{30}} = 3.65$$



Standard normal distribution is 0.00013, it is in rejection region. ∴ we reject the null hypothesis. The new marketing campaign increases the website traffic.

4, A researcher wants to test if the average IQ score of a group of students is different from the national average IQ score of 100. A random sample of 40 students is taken and their average IQ score is 102 with a standard deviation of 15. perform a one sample z-test at a 1% significance level to determine if the groups average IQ score is significantly different from national average.

Ans. $H_0 \Rightarrow \mu = 100$

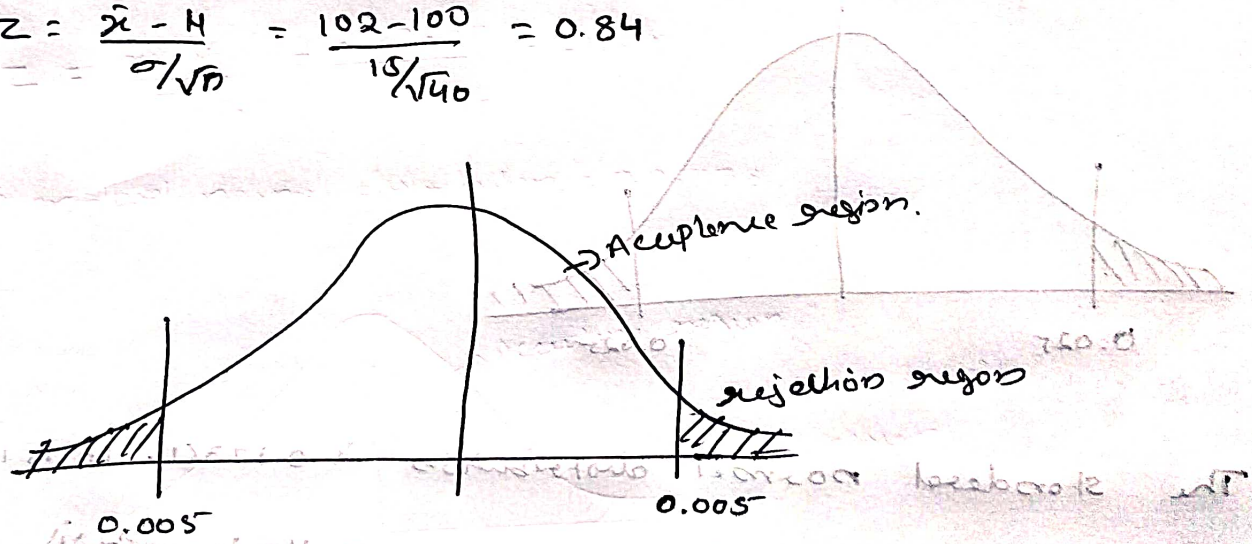
$H_1 \Rightarrow \mu \neq 100$

$\sigma = 15, \quad \alpha = 1\%$.

$\bar{x} = 102, \quad n = 40$

Z-test

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{102-100}{15/\sqrt{40}} = 0.84$$



Standard normal distribution is 0.2 it lies in acceptance region. ∴ we accept the null hypothesis. The groups average IQ score is not different from national average.

5, 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 value of 0.05, is this IQ significantly different than the population mean of 100?

Ans:

$H_0 \rightarrow \mu = 100$

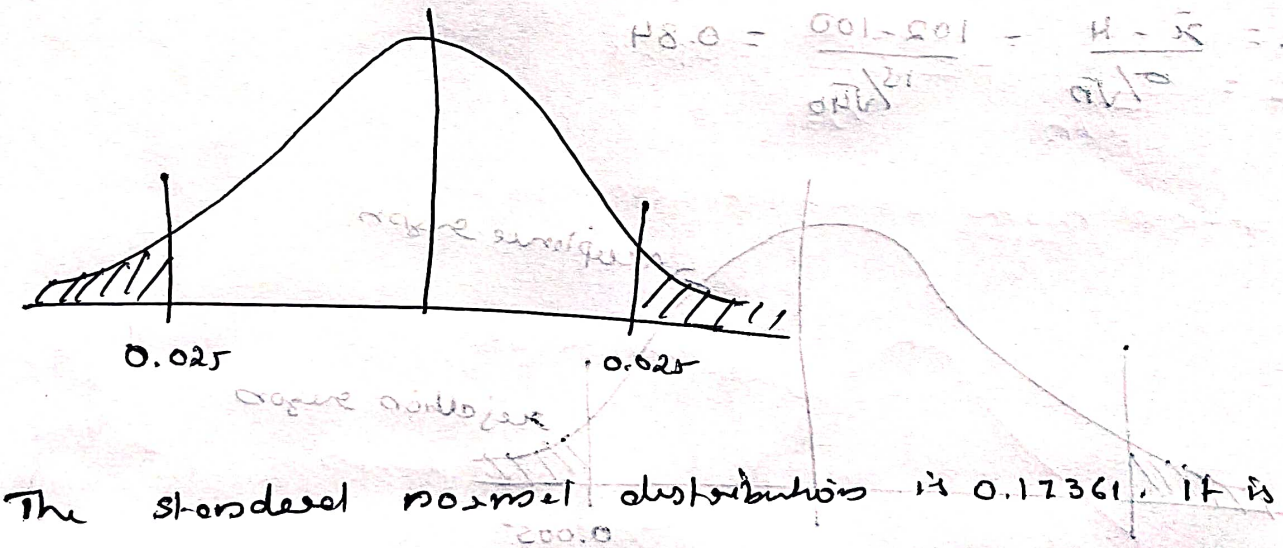
$H_1 \rightarrow \mu \neq 100$

$\sigma = 15$, $\bar{x} = 97.65$

$\alpha = 5\%$, $n = 36$

Z-test

$$Z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{97.65 - 100}{15/\sqrt{36}} = -0.94$$



The standard normal distribution is 0.17361. It is in acceptance region ∴ we accept null hypothesis. There is no change in population mean.