

Assessment - 2

There is an assumption that there is no significant difference between boys & girls with respect to intelligence. Tests are conducted on two groups & the following are the observations

	Mean	Standard Deviation	Size
Girls	89	4	50
Boys	82	9	120

Validate the claim with 5% LOS (Level of significance).

→  $H_0$  (Null Hypothesis): No difference bet<sup>n</sup> Boys & girls in terms of intelligence. ( $\mu_1 = \mu_2$ )

$H_1$  (Alternate Hypothesis): Boys and girls are different in terms of intelligence ( $\mu_1 \neq \mu_2$ )  $\Rightarrow$  two tailed test

$$\bar{x}_1 = 89 \text{ (boys sample mean)}$$

$$\bar{x}_2 = 82 \text{ (girls sample mean)}$$

$$\text{LOS } (\alpha) = 5\%$$

- In this, we have two sample means.  
Hence, this can be solved with two means problem.

Next both sample  $n_1 = 60$  &  $n_2 = 100$  are greater than 30 hence will use Z-test.

Step 1 :-

Calculate z-value from the two mean z-test formulae

$$z = \frac{[(\bar{x}_1 - \bar{x}_2) - (M_2 - M_1)]}{\sqrt{(S_1^2/n_1 + S_2^2/n_2)}}$$

$M_2 - M_1 = 0$  assuming null hypothesis is true.

$$z = (89 - 82) / \sqrt{(150 + 9^2/120)}$$

$$z = \pm \sqrt{0.32} + (0.675)$$

$$z = \pm \sqrt{0.995}$$

$$z = \pm 0.997$$

$$z = \pm 0.02$$

Step 2:-

z critical value for  $\alpha = 5\%$ . from z-table

from z critical value =  $-1.96, +1.96$   
(will get 2 tailed test).

Step 3:-

Hypothesis is  $z$  calculated is outside  $z$  critical then reject null hypothesis.

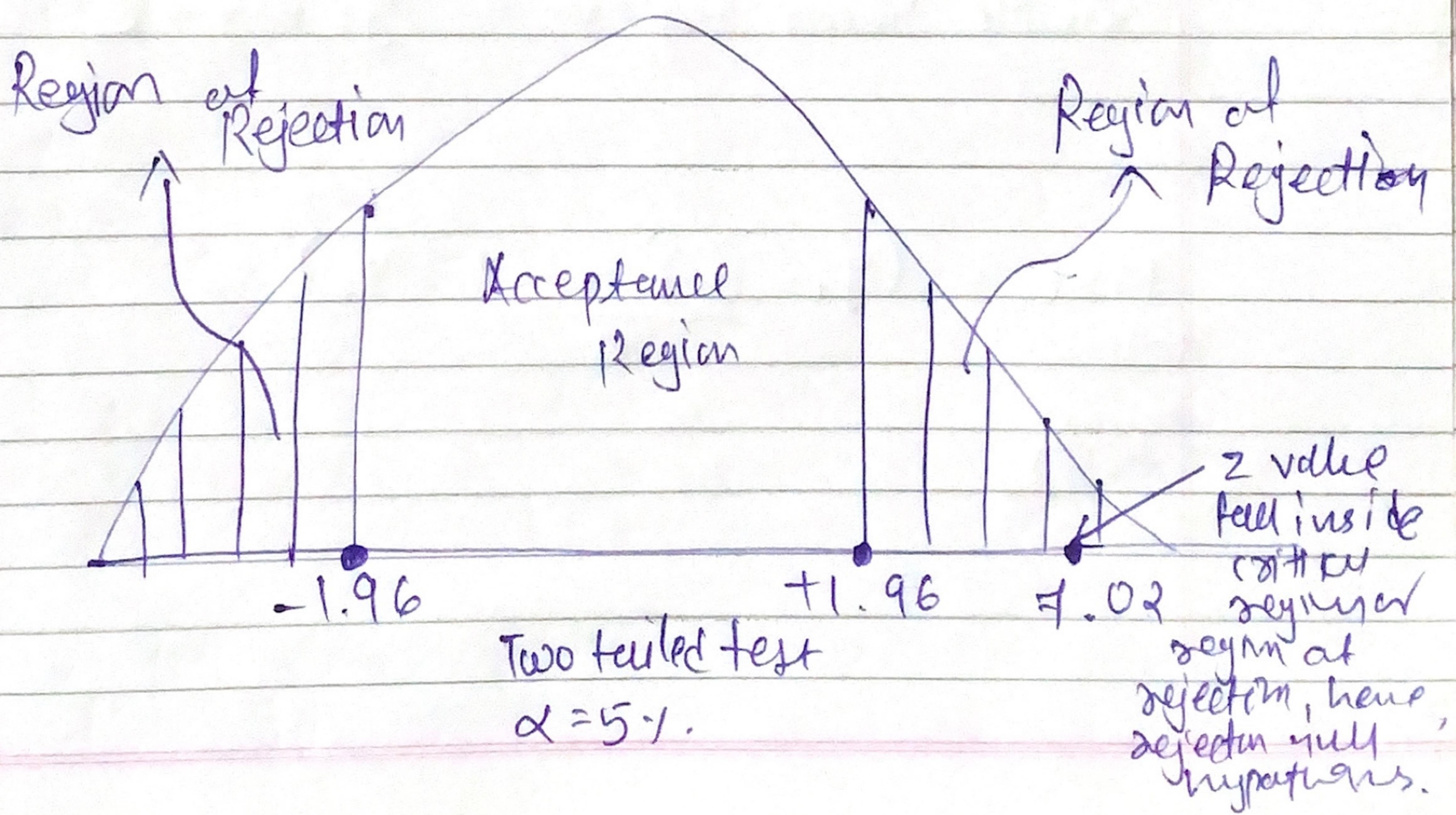
Hence, It will affect the null hypothesis.

- $z$  calculated value = 7.02 is much greater than 1.96.

Conclusion-

With given data it is significantly proven that population mean is not equal to zero

Conclude, with given data it is significantly proven that there is no significant difference between the intelligence of boys & girls



(2)

<u>Category</u>	<u>Diagnosed by Cancer</u>	<u>Without Cancer</u>	<u>Total</u>
Smokers	220	230	550
Non-Smokers	350	640	990
Total	680	910	1590

→ Here, in this question we need to test whether smoking and cancer are independent or dependent to each other. Hence, we will perform chi square test because this test checks the independence of the two categorical variables.

Step 1:-

•  $H_0$  (Null Hypothesis): Cancer is dependent on smoking

$H_1$  (Alternate Hypothesis): Cancer is not dependent on smoking

Step 2:-

we will calculate the expected value for each cell of the table (when  $H_0$  is true).

These → the expected value specifies what the value at each cell of the table would

be if there is no association b/w the two variables.

- The formula for computing the expected values requires the sample size, the row totals, & the column totals.
- ~~Also~~

$$\text{expected value (e)} = (\text{row total} \times \text{column total}) / \text{table total}$$

This table is for observed & expected values both:

Category	Diagnosed w/ Cancer	without cancer	Total
Smokers	$O = 220$ , $e = 550 \times 680 / 1590 = 235.220$	$O = 230$ , $e = 550 \times 910 / 1590 = 314.779$	550
Non-smokers	$O = 350$ , $e = 990 \times 680 / 1590 = 423.396$	$O = 640$ , $e = 990 \times 910 / 1590 = 566.603$	990
Total	680	910	1590

Calculate chi square test value:

$$\chi^2 = \sum [(O - e)^2] / e$$

$$\begin{aligned} \chi^2 = & (220 - 235.220)^2 / 235.220 + (230 - 314.779)^2 / 314.779 \\ & + (350 - 423.396)^2 / 423.396 \\ & + (640 - 566.603)^2 / 566.603 \end{aligned}$$

$$\begin{aligned}
 \chi^2 &= 231.64 / 235.220 + 7187.478 / 314.779 \\
 &\quad + 5384.972 / 423.396 \\
 &\quad + 5387.119 / 566.603 \\
 &= 0.9820 + 22.833 + 12.723 + 9.507 \\
 &= 46.045
 \end{aligned}$$

Step 4:-

If  $\chi^2$  is statistically significant.

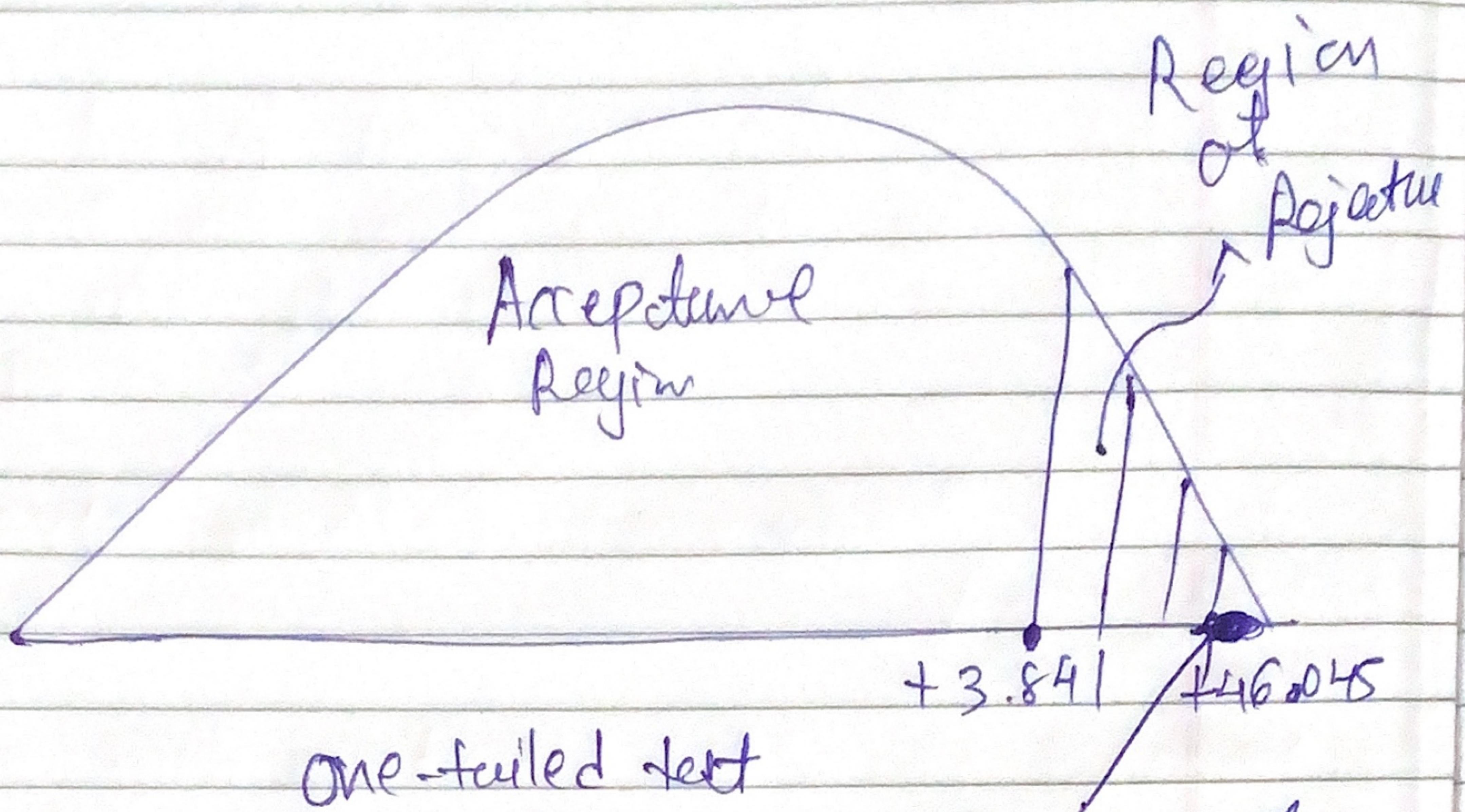
Final step is to determine if the value of chi square test statistic is large enough to reject the null hypothesis.

Now, will check  $\chi^2$  table for the critical value with  $\alpha = 5\%$ .

So from table we got  $\chi^2$  (critical value at  $\alpha = 5\% = 3.841$ )

The chi square value at 46.045 is much larger than critical value of 3.84, so the null hypothesis can be rejected.

Which means, given data, it can be significantly concluded that cancer is not dependent on smoking.



one-tailed test

$$\alpha = 5\%$$

Chi-square value  
fall inside the  
rejection region, hence  
reject the null hypothesis.