CHI - SQUARE TEST:

→ Chi-Square test Claims about population proportions.

→ It is a non parametric test that is performed on Categorical (nominal or ordinal) data.

Problem: [Based on Chi-Square test]

1. In the 2000 Indian Census, the age of the individual in a small town were found to be the following.

Less than 18	Age (18 - 35)	Above 35
20%	30%	50%

In 2010, age of $n = 500$ individuals were Sampled.

Below are the results.

<18	18-35	>35
121	288	91

Would you Conclude the population distribution of ages has Changed in the last 10 years? [using $\alpha = 0.05$]

Given,

In 2000,

<18	18-35	>35
20%	30%	50%

~~In 2010,~~

	<18	18-35	>35	
2010	121	288	91	→ Observed
2000 with respect to Value with Sample mean	$0.2 \times 500 = 100$	$0.3 \times 500 = 150$	$0.5 \times 500 = 250$	→ Expected

	<18	18-35	>35	
2010	121	288	91	Observation
2000	100	150	250	Expected

(i) Null Hypothesis (H_0),

The observation data meets the distribution of 2000 Census.

(ii) Alternate Hypothesis (H_1),

The observation data does not meets the distribution of 2000 Census.

(iii) Significance value $\alpha = 0.05$ (95% of CI)
[Given].

(iv) Degree of freedom $= n-1$

not take $n = 500$, because it is applicable for categorical values. So, take the category of <18, 18-35, >35.

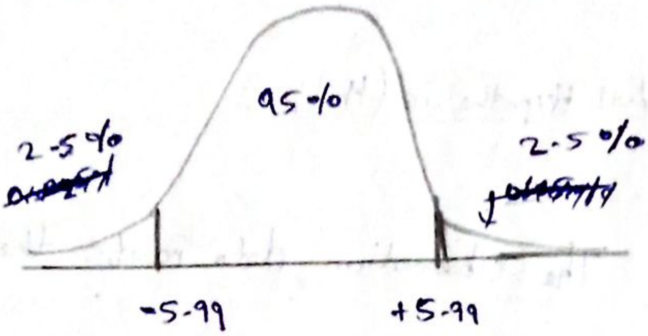
3 different samples.

$= n-1 = 3-1 = 2$ $\boxed{df = 2}$

(V) Decision Boundary,

The Population distribution is high or low. So,

Use two-tail test. [df = 2, α = 0.05]



df = 2, α = 0.05

⇓ Chi-square table Value

5.99

(Vi) Calculate Test Statistics:

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

$f_o \rightarrow$ observation value

$f_e \rightarrow$ expected value

$\chi^2 \rightarrow$ Representation of Chi-square

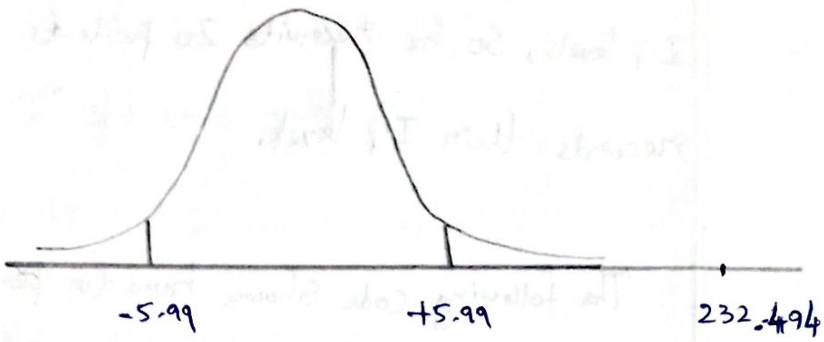
$$= \frac{(121-100)^2}{100} + \frac{(288-150)^2}{150} + \frac{(91-250)^2}{250}$$

$$\boxed{\chi^2 = 232.494}$$

(vii) State Decision:

$\chi^2 = 232.494 > 5.99$ { Reject the null hypothesis }

So, we accept alternate hypothesis.



Obiviously, The population distribution of ages was Changed and increased in the last 10 years.

Z-test	T-Test	CHI-SQUARE TEST
Formula, Point estimate ± margin of Error $\bar{x} \pm z_{\alpha/2}\left(\frac{\sigma}{\sqrt{n}}\right) \to CI$	Formula, Point estimate ± margin of error $\bar{x} \pm t_{\alpha/2}\left(\frac{s}{\sqrt{n}}\right) \to CI$	formula, Test stats $\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$ upperbound = $[\chi^2(1-\alpha), \infty)$ lowerbound = $(0, \chi^2(\alpha)]$
Test Statistics, $z = \frac{\bar{x} - \mu}{\left[\frac{\sigma}{\sqrt{n}}\right]}$	Test statistics, $t = \frac{\bar{x} - \mu}{\left[\frac{s}{\sqrt{n}}\right]}$	$CI = [\chi^2(1-\alpha/2), \chi^2(\alpha/2)]$