Chi-square test | goodness of fit test

Q: 12% of people are left handed. To verify this theory, you took a sample of 75 students, 11 are left handed.
Level of significance 5%.

→

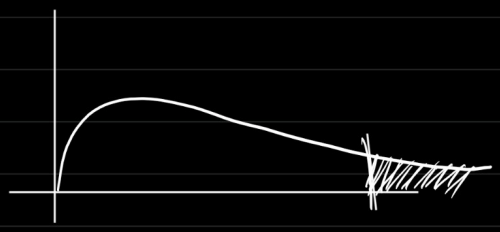
	Observed	Expected
Left	11	9
Right	64	66

12% of 75 $= \frac{12}{100} \times 75 = 9$

Step-1 $H_0 : H = 12\%$, $H_A : H_A \neq 12\%$

Step-2 $\alpha = 5\%$

Step-3 → χ^2 statistics $= \sum \frac{(O-E)^2}{E}$



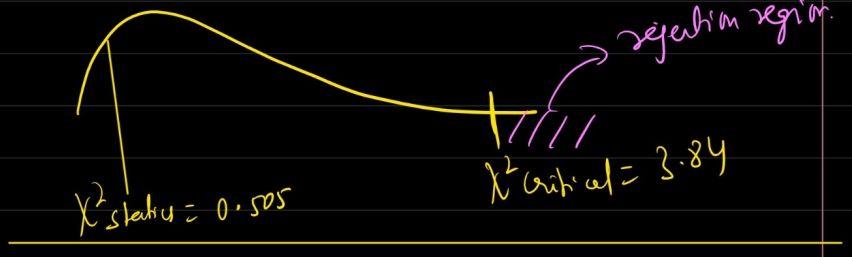
$$\chi^2_{statistics} = \frac{(11-9)^2}{9} + \frac{(64-66)^2}{66} = \frac{2^2}{9} + \frac{2^2}{66} = 0.505$$

Step-4 $\chi^2_{critical}$ for $\alpha = 0.05$

dof = No of groups − 1
= 2 − 1
= 1

$\chi^2_{critical} = 3.84$

Step-5



if $\chi^2_{status} > \chi^2_{critical}$
reject the H_0

* $0.505 < 3.84$
we fail to reject H_0.

* 12% of people are left handed with 95% confidence.

Q. In 2010 census of the city, the weight of people in a city were found to be following :-

<50 kg	50-75 kg	>75 kg
20%	30%	50%

In 2020, weight of 500 people were sampled.

<50	50-75	>75
140	160	200

Using $\alpha = 0.05$, can you conclude the population difference of weight has changed in last 10 years or not?

→ 2016 →

<50	50-75	>75
20%	30%	50%

2020 $n = 500$ observed =

<50	50-75	>75
140	160	200

Expectation =

<50	50-75	>75
$0.2 \times 500 = 100$	$0.3 \times 500 = 150$	$0.5 \times 500 = 250$

Step-1 → H_0 : The data is as per expectation.
H_A : The data is not as per expectation

Step-2 - $\alpha = 0.05$.

Step-3 - χ^2 statistics $= \sum \frac{(O-E)^2}{E} = \frac{(140-100)^2}{100} + \frac{(160-150)^2}{160} + \frac{(200-250)^2}{250}$

$= \frac{1600}{100} + \frac{100}{160} + \frac{2500}{2500}$

$= 16 + 0.66 + 10 = 26.66$

Step-4 $\chi^2_{critical}$ $\alpha = 0.05$,

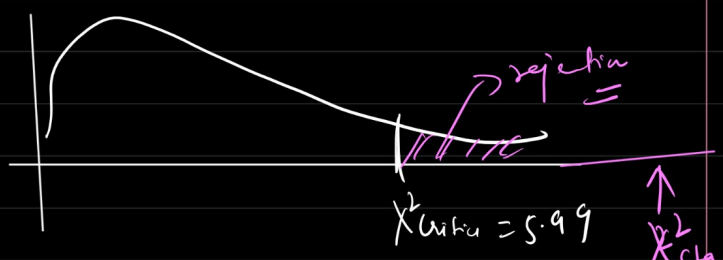
$dof = 3 - 1 = 2$

$\chi^2_{crit\ 0.05, dof\ 2} = 5.99$

Step: 5 if $\chi^2_{stats} > \chi^2_{critical}$ — Reject the H_0

$26.66 > 5.99$

reject H_0.



Conclusion — The weight of 2020 population are different those expected in 2010 population.