



DEPARTMENT OF MATHEMATICS

UNIT- IV TESTING OF HYPOTHESIS

CHI - SQUARE TEST :

$$\chi^2 = \frac{\sum [O_i - E_i]^2}{E_i}$$

where $O_i \rightarrow$ Observed frequency

$E_i \rightarrow$ Experimental frequency or Expected frequency
 $= \frac{\sum O_i}{n}$

degrees of freedom, $v = n - 1$

properties:

- i) The mean of χ^2 dist. is equal to the no. of degrees of freedom
- ii) The variance of χ^2 dist. is twice the degrees of freedom
- iii) If χ^2 is a chi-square variate with v degrees of freedom, then $\chi^2/2$ is a gamma variate with parameter $v/2$.
- iv) Standard χ^2 variate tends to standard normal variate as $n \rightarrow \infty$.

Applications:

- i) To test if the hypothetical value of the population variance is $\sigma^2 = \sigma_0^2$
- ii) To test the goodness of fit.
- iii) To test the independence of attributes.
- iv) To test the homogeneity of indep. estimates of the population variance.

Degrees of freedom: no. of values in a set which may be assigned arbitrarily.



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1) The table below gives the number of aircraft accidents that occurred during the various days of the week. Test whether the accidents are uniformly distributed over the week.

Days	: Mon	Tues	Weel	Thurs	Fri	Sat
No. of accidents	: 14	18	12	11	15	14

Soln:

Given, Total no. of accidents = 84

No. of days = 6

\therefore Expected frequencies of the accidents $= \frac{84}{6}$
 $= 14$

O_i	E_i	$(O_i - E_i)^2$	$\frac{(O_i - E_i)^2}{E_i}$
14	14	0	0/14 : 0
18	14	16	16/14 : 1.14
12	14	4	4/14 : 0.285
11	14	9	9/14 : 0.642
15	14	1	1/14 : 0.071
14	14	0	0/14 : 0

$$\sum \frac{(O_i - E_i)^2}{E_i} = 2.14285$$

Step 1: Formulate H_0 & H_1 :-

H_0 : The accidents are uniformly distributed.

H_1 : The accidents are not uniformly distributed.

Step 2: Los at $\alpha = 5\%$.

Step 3: Test statistic, $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} = 2.1428$



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Step 4: Degrees of freedom, $\nu = n-1$

$$= b-1$$

$$= 5$$

Tab value is $11.04 = \chi^2_{\alpha}$

Step 5: Conclusion:

$$\chi^2 = 2.1428 < 11.04 = \chi^2_{\alpha}$$

$\therefore H_0$ is accepted at 5% los. (u) The accident are uniformly distributed.

2) A die was thrown 498 times. Denoting x to be the number appearing on the top face of it, the observed frequency of x is given below:

x : 1 2 3 4 5 6

f : 69 78 85 82 86 98

what opinion you would form for the accuracy of the die?

Soln:

Given, Expected frequency, $E_i = \frac{\text{Total frequency}}{b}$

$$= \frac{498}{6} = 83$$



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O_i	E_i	$(O_i - E_i)^2$	$(O_i - E_i)^2 / E_i$	
1	69	83	196	2.3614
2	78	83	25	0.3012
3	85	83	4	0.0481
4	82	83	1	0.0120
5	86	83	9	0.1084
6	98	83	225	2.7108
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$\frac{\sum (O_i - E_i)^2}{E_i} = 5.5419$				

Step 1: Formulate H_0 & H_1 :

H_0 : A die is unbiased

H_1 : A die is not unbiased i.e. biased.

Step 2: Los at $\alpha = 5\%$.

Step 3: Test statistic, $\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} = 5.542$.

Step 4: Degrees of freedom, $v = n - 1$
 $= 6 - 1$
 $= 5$

$$\therefore \chi^2_{\alpha} = 11.07$$

Step 5: Conclusion;

$$\chi^2 = 5.542 < 11.07 = \chi^2_{\alpha}$$

$\therefore H_0$ is accepted at 5% Los @ A die is unbiased