Q3) i) A coin was tossed 400 times & the head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% level of significance.

Soln

Suppose the coin is unbaised.

Then the probability of getting the head in a toss $= 1/2$

$\therefore$ expected number of successes $= 1/2 \times$

The observed value of successes $= 216$.

Thus the excess of observed value over expected value $= 216 - 200 = 16$

Also SD of simple sampling $= \sqrt{npq}$

$$= \sqrt{\left(400 \times \frac{1}{2} \times \frac{1}{2}\right)} = 10$$

$$z = \frac{x - np}{\sqrt{(npq)}} = \frac{16}{10} = 1.6$$

Page :
Date: / /

As $z \le 1.96$, the hypothesis is accept at 5% level of significance i.e, we conclude that the coin is unbaised at 5% level of sigificance.

ii) A survey of 240 families with 4 children shows the following distribution:

no. of boys	4	3	2	1	0
no. of families	10	55	105	58	12

Test the hypothesis that male & female births are equal probable.

Sol^n

Null hypothesis, H_0: Male & female are equally probable.

no. of boys	4	3	2	1	0
no. of girls	0	1	2	3	4
no. of families	10	55	105	58	12

400=200 Alternate hypothesis H_1 : Male & female birth are not equally probable, calculateon of expected frequencies $(q+p)^n$;

probability of female birth $= p = \frac{1}{2}$

probability of male birth $= q = \frac{1}{2}$

$$(p+q)^n = q^n + {}^nC_1 p q^{n-1} + {}^nC_2 p^2 q^{n-2} + {}^nC_3 p^3 q^{n-3} \ldots$$

$$= \left(\frac{1}{2}\right)^4 + 4\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^3 + 6\left(\frac{1}{2}\right)^2\left(\frac{1}{2}\right)^2 + 4\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right) + \left(\frac{1}{2}\right)$$

No. of girls $= 240\left[\frac{1}{16} + \frac{4}{16} + \frac{6}{16} + \frac{4}{16} + \frac{1}{16}\right]$

Scanned with CamScanner

Page :
Date: / /

$= 240 \times \frac{1}{16} + 240 \times \frac{4}{16} + 240 \times \frac{6}{16} + 240 \times \frac{4}{16} + 240 \times \frac{1}{16}$

$= 15 + 60 + 90 + 60 + 15$

These are the expected frequency of female births.

O	E	O − E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
10	15	−5	25	1.67
55	60	−5	25	0.41
105	90	15	225	2.5
58	60	−2	4	0.067
12	15	−3	9	0.6
			Total	5.247

Given $\chi^2_{0.05} = 9.49$ & 11.1 for 4 d.f. and 5 d.f.
Science the calculated value of χ^2 (5.247) < χ^2 value at 4 d.f. and 5 d.f.
Hence, the null hypothesis is accepted i.e, the male & female birth is equally probable.