

## SEC-4

(2) If suppose the coin is unbiased. Then the probability of getting the head in a toss  $= \frac{1}{2}$

$\therefore$  Expected number of successes  $= \frac{1}{2} \times 400 = 200$

The observed value of successes  $= 216$

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

Also SD of simple sampling  $= \sqrt{npq} = \sqrt{400 \times \frac{1}{2} \times \frac{1}{2}}$   
 $= 10$

Hence  $Z = \frac{n - np}{\sqrt{npq}} = \frac{16}{10} = 1.6$

As  $Z < 1.96$  the hypothesis is accepted at 5% of significance. i.e., we conclude that the coin is unbiased at 5% level of significance.

iii) 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 family	10	55	105	58	12

Alternative hypothesis  $H_1$ : Male & Female birth are not equally probable.  
Calculation of expected frequencies  $(p+q)^n$ ,

Probability of female birth  $= p = 1/2$

Probability of male birth  $= q = 1/2$

$$(p+q)^n = q^n + {}^n C_1 p q^{n-1} + {}^n C_2 p^2 q^{n-2} + {}^n C_3 p^3 q^{n-3} + \dots + p^n$$

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

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

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

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

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

These are the expected frequencies of female birth

O	E	O-E	(O-E) <sup>2</sup>	$\frac{(O-E)^2}{E}$
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  $\chi^2_{0.05} = 9.49$  and 11.1 for 4 d.f and 5 d.f  
Since the calculated value of  $\chi^2 (5.247) < \chi^2$  value at 4 d.f and 5 d.f  
Hence the null hypothesis is accepted i.e. the male and female birth is equal probable.