Section-4

Q2

Ans (a) Suppose the coin is unbaised

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

i.e. Expected no. of successes $= 1/2 \times 400 = 200$

The observed value of successes $= 216$

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

also,
S.D of simple sampling $= \sqrt{npq}$

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

$$= 10$$

Hence,

$$Z = \frac{x - np}{\sqrt{npq}} = \frac{16}{10}$$

$$Z = 1.6$$

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

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(b) 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

- Alternate hypothesis, H_1 :- Male & female birth are not equally proble.
- Calculation of expected frequencies $(q+p)^n$,
- probability of female birth $= p = \frac{1}{2}$
- Probability of male birth $= q = \frac{1}{2}$

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

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

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

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

$= 15 + 60 + 90 + 60 + 15$
$= 240$

- These are the expected frequencies of girls 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, $\chi^2_{0.05} = 9.49$ and 11.1 for 4 d.f. & 5 d.f.

Since the calculated value is accepted i.e., the male & female birth is equally proble.