2. Ans

suppose the coin is unbaised.

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

∴ Expend 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 SD of simple sampling = $\sqrt{npq} = \sqrt{(400 \times \frac{1}{2} \times \frac{1}{2}}$

$= 10$

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

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

→ Null hypothesis. H_0 :- Male and female are equally probable

No. of boys.	4	3	3	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 Probable calculation of expected frequencies $(q+p)^n$.

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

Probability of male birth $= \frac{1}{2}$

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

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

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

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

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

These are the expected frequencies 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 & 5 d.f.

Since the calculated value of χ^2 $(5.247) < \chi^2$ value at 4 d.f. and 5 d.f.