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Ans. 1. Let X be number of successes then X follows $b(n, p)$.

Number of trials $= 4 = n$

Probability of success $= P$(getting a number greater than 2)

$$p = \frac{4}{6} = \frac{2}{3}$$

Probability of failure $= 1 - p = 1 - \frac{2}{3} = \frac{1}{3}$

$$q = \frac{1}{3}$$

i) Exactly one success $= P(X=1)$

$$= {}^4C_1 \left(\frac{2}{3}\right)^1 \left(\frac{1}{3}\right)^{4-1}$$

$$= 4 \times \frac{2}{3} \times \frac{1}{3^3}$$

$$= \frac{8}{81} = \underline{0.0987}$$

ii) Less than 3 successes $= P(X<3)$

$$= P(X=0) + P(X=1) + P(X=2)$$

$$= {}^4C_0 \left(\frac{2}{3}\right)^0 \left(\frac{1}{3}\right)^4 + {}^4C_1 \left(\frac{2}{3}\right)^1 \left(\frac{1}{3}\right)^3 + {}^4C_2 \left(\frac{2}{3}\right)^2 \left(\frac{1}{3}\right)^2$$

$$= \frac{33}{81} = \underline{0.4074}$$

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Ans.2. Let X be number of busy telephone lines.
Then X follows $b(n,p)$

Number of telephone lines $= 5 = n$

Probability of success = Probability of any telephone line being busy

$= 0.01 = p$

Probability of failure $= 1-p = 1-0.01$

$= 0.99 = q$

i) All lines are busy $= P(X=5)$

$= {}^5C_5\, p^5 q^{5-5}$

$= {}^5C_5 (0.01)^5 (0.99)^0$

$= (10^{-2})^5 = \underline{10^{-10}}$

ii) More than 3 lines are busy $= P(X>3)$

$= P(X=4) + P(X=5)$

$= {}^5C_4 (0.01)^4 (0.99)^1 + {}^5C_5 (0.01)^5 (0.99)^0$

$= 5 \times 10^{-8} \times 0.99 + 10^{-10}$

$= 10^{-10}(5 \times 99 + 1)$

$= \underline{496 \times 10^{-10}}$

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Ans. 3. Let X be number of misprints, then X follows poisson distribution.

We know probability of no misprint is e^{-4}

$\therefore P(X=0) = e^{-4}$

$\because P(X=x) = \frac{e^{-\mu}\mu^{x}}{x!}$

$\therefore P(X=0) = \frac{e^{-\mu}\mu^{0}}{0!}$

$e^{-4} = e^{-\mu}$

$\Rightarrow \mu = 4$

$\therefore$ Probability of more than two misprints

$= P(X>2) = 1 - P(X\leq 2)$

$= 1 - [P(X=0) + P(X=1) + P(X=2)]$

$= 1 - \left[\frac{e^{-4}.4^{0}}{0!} + \frac{e^{-4}.4}{1!} + \frac{e^{-4}.4^{2}}{2!}\right]$

$= 1 - e^{-4}[1+4+8] = 1 - 13e^{-4}$

$= 1 - 0.2381 = 0.7618$

Ans. 4. Number of trials, $n = 6400$

Probability of success, p = Probability of getting 6 heads

$= \frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$

$= \frac{1}{2^{6}} = \frac{1}{64}$

$\because n\to\infty$ and $p\to 0$, thus poisson distribution is the limiting form of binomial distribution $b(6400, 1/64)$.

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For binomial distribution, mean, $\mu = np$

$$\mu = 6400 \times \frac{1}{64}$$

$$\underline{\mu = 100}$$

$\therefore$ X be number of times we get 6 heads

Probability of getting 6 heads 10 times $= P(X=10)$

$$= \frac{e^{-100} \times 100^{10}}{10!}$$

$$= \underline{1.0251 \times 10^{-30}}$$

Ans. 5.

x	f	xf
0	122	0
1	60	60
2	15	30
3	2	6
4	1	4
	200	100

$\Sigma xf = 100$

$\Sigma f = 200 = N$

$\therefore$ Mean, $\mu = \frac{\Sigma xf}{N} = \frac{100}{200} = 0.5$

$\therefore$ fitting a Poisson distribution with $\mu = 0.5$

$\because$ Poisson distribution is

$$= N \times \frac{e^{-\mu} \mu^{x}}{x!}$$

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For $x = 0$, Expected frequency $= \frac{e^{-0.5} (0.5)^0}{0!} \times 200$

$= 121.3061$

$\simeq 121$

For $x = 1$, Expected frequency $= \frac{e^{-0.5} (0.5)^1}{1!} \times 200$

$= 60.6530$

$\simeq 61$

For $x = 2$, Expected frequency $= \frac{e^{-0.5} (0.5)^2}{2!} \times 200$

$= 15.1632$

$\simeq 15$

For $x = 3$, Expected frequency $= \frac{e^{-0.5} (0.5)^3}{3!} \times 200$

$= 2.5272$

$\simeq 3$

For $x_1 = 4$, Expected frequency $= \frac{e^{-0.5} (0.5)^4}{4!} \times 200$

$= 0.3159$

$\simeq 0$

x	f	ef
0	122	121
1	60	61
2	15	15
3	2	3
4	1	0