DPP-5 Maths - IV Unit - 4

Topic - Binomial Distribution - 2

Q-1 - Out of 800 families with 4 children each, how many families would be expected to have i) 2 boys 2 girls ii) at least one boy iii) no girl iv) almost two girls ?

Sol - Since probabilities for boys and girls are equal

p = probability of boy = $\frac{1}{2}$

q = probability of girl = $\frac{1}{2}$

$n = 4$

$N = 800$

i) The expected number of families having 2 boys and 2 girls

$$= 800 \times \left[{}^4C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^2 \right]$$

$$= 800 \times 6 \times \frac{1}{16}$$

$$= 300$$

ii) The expected number of families having atleast one boy

$$NP(r \geq 1) = 800 \left[{}^4C_1 \left(\frac{1}{2}\right)^3 \left(\frac{1}{2}\right) + {}^4C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^2 + {}^4C_3 \left(\frac{1}{2}\right) \left(\frac{1}{2}\right)^3 + {}^4C_4 \left(\frac{1}{2}\right)^4 \right]$$

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$= 800 \times \frac{1}{16} [4+6+4+1]$

$= 750$

iii) The expected no. of families having no girl i.e, having 4 boys.

$NP(r=4) = 800 \times {}^4C_4 \left(\frac{1}{2}\right)^4$

$= 800 \times \frac{1}{16}$

$= 50$

iv) The expected number of families having atmost two girls, having at least 2 boy.

$NP(r \geq 2) = 800 \left[{}^4C_2 \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^2 + {}^4C_3 \left(\frac{1}{2}\right)^3 \left(\frac{1}{2}\right) + {}^4C_4 \left(\frac{1}{2}\right)^4 \right]$

$= 800 \times \frac{1}{16} [6+4+1]$

$= 550$

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Q-2: A bag contains 5 white, 7 red, 8 black balls. If four balls are drawn, one by one, with replacement what is probability that

i) none is white
ii) all are white
iii) at least one is white
iv) only two are white

Sol- $n = 4$

$$p(\text{drawn white ball}) = \frac{5}{20} = \frac{1}{4}$$

$$q = 1 - \frac{1}{4} = \frac{3}{4}$$

i) none is white $(X = 0) = {}^4C_0 \left(\frac{1}{4}\right)^0 \left(\frac{3}{4}\right)^4$

$$= \frac{81}{256}$$

ii) all are white $(X = 4) = {}^4C_4 \left(\frac{1}{4}\right)^4 \left(\frac{3}{4}\right)^0$

$$= \frac{1}{256}$$

iii) atleast one is white = 1 - no white

$$= 1 - \frac{81}{256}$$

$$= \frac{175}{256}$$

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iv) Only two are white $(X=2) = {}^4C_2 \left(\frac{1}{4}\right)^2 \left(\frac{3}{4}\right)^2$

$$= \frac{4!}{2!\times 2!} \times \frac{1}{16} \times \frac{9}{16}$$

$$= \frac{\cancel{4} \times 3 \times 9}{\cancel{2} \times \cancel{16}^{8} \times 16}$$

$$= \frac{27}{128}$$

Q-3- Five cards are drawn successively with replacement from a well-shuffled deck of 52 cards. What is the probability that

i) all the five cards are spade
ii) only three are spades
iii) none is spade

Sol- In a well shuffled deck of 52 cards, there are 13 cards.

$$p = \frac{13}{52} = \frac{1}{4}$$

$$q = 1 - \frac{1}{4} = \frac{3}{4}$$

$n = 5$

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i) $P(r=5) = {}^5C_5 \left(\frac{3}{4}\right)^0 \left(\frac{1}{4}\right)^5$

$= \left(\frac{1}{4}\right)^5$

ii) $P(r=3) = {}^5C_3 \left(\frac{3}{4}\right)^2 \left(\frac{1}{4}\right)^3$

$= 10 \times \frac{9}{16} \times \frac{1}{4^3}$

$= 90 \times \left(\frac{1}{4}\right)^5$

iii) $P(r=0) = {}^5C_0 \left(\frac{3}{4}\right)^5 \left(\frac{1}{4}\right)^0$

$= \frac{243}{1024}$

Ans

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