Cambridge International AS & A Level

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Mathematics 9709/52

Paper 5 Probability & Statistics 1 **October/November 2024**

Question No(1)

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At a college, the students choose exactly one of tennis, hockey or netball to play. The table shows the numbers of students in Year 1 and Year 2 at the college playing each of these sports.

	Tennis	Hockey	Netball
Year 1	16	22	12
Year 2	24	18	28

One student is chosen at random from the 120 students. Events X and N are defined as follows:
X: the student is in Year 1

N: the student plays netball.

(a) Find P(X|N)

(b) Find P(N|X)

(c) Determine whether or not X and N are independent events.

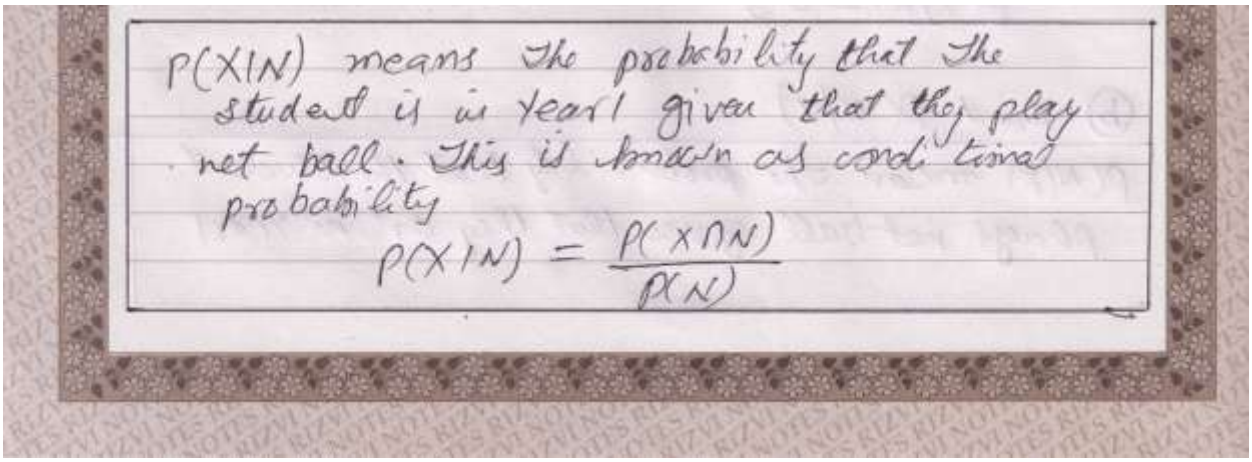
One of the students who plays netball takes 8 shots at goal. On each shot, the probability that she will succeed is 0.15, independently of all other shots.

(d) Find the probability that she succeeds on fewer than 3 of these shots.

Solution:

(a)

Find P(X|N)



Given data:

Total students = 120

Total netball players in Year 1 and Year 2

= 12 + 28 = 40

Netball players in Year 1 = 12

$$P(X/N) = \frac{P(X \cap N)}{P(N)}$$

$P(X \cap N) = \frac{12}{120}$ ∴ Student in Year 1 are 12

$P(N) = \frac{40}{120}$ ∴ Netball Students in Year 1 and Year 2 are 40

$$P(X/N) = \frac{12/120}{40/120}$$

$$= \frac{12}{40}$$

$$P(X/N) = \frac{3}{10}$$

$$P(X/N) = 0.3$$

(b) Find $P(N/X)$

$P(N/X)$ mean the probability that the student plays netball given that they are in Year 1

DATE:- (3)

Given data:

total Year 1 Students = 50

Netball players in Year 1 = 12

$$P(N/X) = \frac{P(N \cap X)}{P(X)}$$

Here $P(N \cap X) = \frac{12}{120}$

$P(X) = \frac{50}{120}$

NOW $P(N/X) = \frac{P(N \cap X)}{P(X)}$

$$= \frac{12/120}{50/120}$$

$$= \frac{12}{50}$$

$$= 6/25$$

$P(N/X) =$

(c) Determine whether or not X and N are independent events

Solution

Two events X and N are independent if and only if

$$P(X \cap N) = P(X) \cdot P(N)$$

Total no of students $= 120$

$$P(X) = \frac{50}{120} = \frac{5}{12}$$

$$P(N) = \frac{40}{120} = \frac{1}{3}$$

$$P(X \cap N) = \frac{12}{120} = \frac{1}{10}$$

Now

$$P(X) \cdot P(N) = \frac{5}{12} \cdot \frac{1}{3}$$

$$= \frac{5}{36}$$

and $P(X \cap N) = \frac{1}{10}$

$$\Rightarrow P(X) \cdot P(N) \neq P(X \cap N)$$

So X and N are not independent

(d)

Binomial probability Formula

$$P(X=k) = \binom{n}{k} p^{k} (1-p)^{n-k}$$

Given data

Number of shots, $n=8$

probability of success on each shot, $p=0.15$

probability of failure on each shot, $q=1-p$

$=1-0.15$

$q = 0.85$

By given condition

$$P(X<3) = P(X=0) + P(X=1) + P(X=2)$$

$$= \binom{8}{0}(0.15)^{0}(0.85)^{8} + \binom{8}{1}(0.15)^{1}(0.85)^{8-1} + \binom{8}{2}(0.15)^{2}(0.85)^{8-2}$$

$$P(X<3) = \binom{8}{0}(p)^{0}(q)^{8-0} + \binom{8}{1}p^{1}(q)^{8-1} + \binom{8}{2}p^{2}(q)^{8-2}$$

$P(X<3) = 0.2725 + 0.3855 + 0.2381$

$P(X<3) = 0.896$