Chapter 14
Probability

Exercise 14.1

4. n = Total no. of cards = 52

a. No. of club = 13

No. of diamond = 13

m = No. of possible cases = 13 + 13 = 26

P(Either a club or diamond) = $\frac{m}{n} = \frac{26}{52} = \frac{1}{2}$

b. There are four kings

$\therefore$ No. of possible cases = 52 – 4 = 48

$\therefore$ P(Not of king) = $\frac{48}{52} = \frac{12}{13}$

c. There are 12 face cards and 13 club cards.

$\therefore$ m = no. of cases = 12 + 13 – 3 = 22

$\therefore$ P(Either a face or a club) = $\frac{m}{n} = \frac{22}{52} = \frac{11}{26}$

5. From 20 tickets marked from 1 to 20, one is drawn at random. Find the probability that

a. It is an odd number

b. A multiple of 4 or 5

Solution:

a. P(Odd number) = ?

Among 20 tickets, there are 10 tickets marked with odd number.

$\therefore$ P(Odd number) = $\frac{m}{n} = \frac{10}{20} = \frac{1}{2}$

b. P(A multiple of 4 or 5) = ?

There are 5 tickets marked with multiple of 4 and 4 tickets marked with multiple of 5.

= P(Multiple of 4) + P(multiple of 5) – P(Multiple of 4) $\times$ P(Multiple of 5)

$= \frac{5}{20} + \frac{4}{20} - \frac{5}{20} \times \frac{4}{20} = \frac{2}{5}$

6. Given that,

P(A) = Probability that A solves the problem = $\frac{1}{2}$

P(B) = Probability that B solves the problem = $\frac{1}{3}$

P(C) = Probability that C solves the problem = $\frac{1}{4}$

P(D) = Probability that D solves the problem = $\frac{1}{5}$

P($\overline{A}$) = Probability that A not solve the problem = $1 - \frac{1}{2} = \frac{1}{2}$

P($\overline{B}$) = Probability that B not solve the problem $1 - \frac{1}{3} = \frac{2}{3}$

$P(\overline{C})$ = Probability that C not solve the problem = $1 - \frac{1}{4} = \frac{3}{4}$

$P(\overline{D})$ = Probability that D not solve the problem = $1 - \frac{1}{5} = \frac{4}{5}$

b. Probability that A, B, C, D not solve the problem = $\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{4} \cdot \frac{4}{5} = \frac{1}{5}$

a. Probability that A, B, C, D solve the problem = $1 - \frac{1}{5} = \frac{4}{5}$

7. Suppose 4 cards are drawn from a well-shuffled deck of 52 cards.
   a. What is the probability that all 4 are spade?
   b. What is the probability that all 4 are black?

Solution:

a. There are 13 spades

Now, n = Total no. of possible cases

= No. of selection of 4 cards out of 52

= $52c_4$

= No. of favourable cases

= No. of selection of 4 spades out of 13 = $13c_4$

P(4 are spades) = ?

Now, P(4 are spades) = $\frac{m}{n} = \frac{13c_4}{52c_4} = \frac{13!}{9!\ 4!} \times \frac{48! \times 41}{52!} = \frac{11}{4165}$

b. There are 26 black. So, we have to choose 4 black among 26 blacks.

Now, n = Total no. of possible cases

= No. of selection of 4 cards out of 52 = $52c_4$

m = No. of favourable cases

= No. of selection of 4 black out of 26 black

= $26c_4$

P(4 are black) = ?

Now, P(4 are black) = $\frac{m}{n} = \frac{26c_4}{52c_4} = \frac{46}{833}$

8. Solution:

a. Two cards can be drawn from a pack of 52 playing cards in ${}^{52}C_2$ ways

i.e. $\frac{52 \times 51}{2}$ = 1326 ways

The event that two kings appear in a single draw can appear in ${}^{4}C_2$ ways

∴ The probability that the two cards drawn from a pack of 52 cards are kings

$= \frac{6}{1326} = \frac{1}{221}$

b. One king and one queen can be selected as $\frac{4}{52} \times \frac{4}{51}$ ways.

One queen and one king can be selected as = $\frac{4}{52} \times \frac{4}{51}$ ways

Total no. of ways = $\frac{4}{52} \times \frac{4}{51} + \frac{4}{52} \times \frac{4}{51} = \frac{8}{663}$

9. Here,

Total no. of candidates = 9

Total no. of men = 6

Total no. of women = 3

Total no. of vacancy = 2

∴ Out of 2, one man and one woman can be selected in the following ways.

∴ $m = bc_1 \times 9c_1$

∴ Total no. of vacancy can be chosen from total no. of candidates as

$n = 9c_2$

∴ $P(\text{1 man and 1 woman}) = \frac{6c_1 \times 9c_1}{9c_2} = \frac{18}{36}\ 0.5$

10. Since the bag consists of 7 white and 9 black balls.

∴ Total balls = 7 + 9 = 16

Total number of possible cases means the number of selection of 2 balls out of 16.

Since, the selection of 1 white and 1 black. So, the number of favourable cases is the selection of balls with 1 white and 1 black

∴ m = No. of favourable cases

= No. of selection of 1 white out of 7 and 1 black out of 9

$= 7c_1 \times 9c_1$

n = Total no. of possible cases

= No. of selection of 2 balls out of 16.

$= 16c_2$

∴ $P(\text{1 white and 1 black}) = \frac{m}{n} = \frac{7c_1 \times 9c_1}{16c_2} = \frac{63}{120}$

11. There are 6 + 8 = 14 balls (Total)

a. P(both white) = ?

$P(\text{First white}) = \frac{6}{14}$ and $P(\text{second white}) = \frac{5}{13}$

$P(\text{Both white}) = \frac{6}{14} \times \frac{5}{13} = \frac{15}{91}$

b. P(Both red) = ?

$P(\text{First red}) = \frac{8}{14}$, $P(\text{Second red}) = \frac{7}{13}$

∴ $P(\text{Both red}) = \frac{8}{14} \times \frac{7}{13} = \frac{4}{13}$

c. Since balls are drawn one after another without replacement.

P(One red and one white) = ?

∴ $P(\text{First red}) = \frac{8}{14}$, $P(\text{Second white}) = \frac{6}{13}$

$P(\text{First white}) = \frac{6}{14}$ $P(\text{Second red}) = \frac{8}{13}$

∴ $P(\text{One red and one white}) = \frac{6}{14} \times \frac{8}{13} + \frac{8}{13} \times \frac{6}{13} = \frac{48}{91}$

12. Given, P(A) = 0.40, P(B) = 0.80, P(B/A) = 0.60, P(A/B) = ? P(A∪B) = ?

∴ $P(B/A) = \frac{P(A \cap B)}{P(A)}$

⇒ $P(A \cap B) = P(A) . P(B/A) = 0.40 \times 0.60 = 0.24$

∴ $P(A/B) = \frac{P(A \cap B)}{P(B)} = \frac{0.24}{0.80} = 0.3$

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

$= 0.40 + 0.80 - 0.3$

= 0.9

13. A box contains six red and four black balls. Two balls are drawn one at a time without replacing the first ball compute $P(R_2/131)$. Also find the probability that both are red balls.

Solution:

$P(R_2/B_1)$ = Probability of getting a red ball given that the first ball is black.

First black ball

n = Total no. of possible cases

Total no. of balls = 6 + 4 = 10

m = No. of favourable cases

= No. of black balls

= 4

$P(B_1) = \frac{m}{n} = \frac{4}{10}$

Second Red Ball

One black ball which is drawn is not replaced.

n = Total no. of possible cases

= No. of remaining balls

= 6 + 3 = 9

m = No. of favourable cases

= No. of red balls = 6

$P(R_2/B_1)\ \frac{m}{n} = \frac{6}{9} = \frac{2}{3}$

$P(R_1)$ = Probability of getting a red ball

$= \frac{m}{n} = \frac{6}{10}$

$P(R_2/R_1)$ Probability that second ball is red when first also red $= \frac{m}{n} = \frac{5}{9}$

$\therefore\ P(R_1 \cap R_2) = P(R_1) . P(R_2/R_1)$

$= \frac{6}{10} \times \frac{5}{9} = \frac{1}{3}$

14. A lot contains 12 items of which 5 are defective. If 5 items are chosen from the lot at random. One after another without replacement. Find the probability that all the five are defective.

Solution: We have,

No. of total items = 12

No. of defective items = 5

$\therefore$ Probability of getting first item defective, $P(A) = \frac{5}{12}$

Since, second item is drawn without replacement of first items.

So, probability of getting second item defective $P(B) = \frac{4}{11}$

Similarly,

Probability of getting 3^{rd} item defective, $P(C) = \frac{3}{10}$

Probability of getting 4^{th} item defective, $P(D) = \frac{2}{9}$

Probability of getting 5^{th} item defective, $P(E) = \frac{1}{8}$

Probability of getting all items defective

$= P(A) \times P(B) \times P(C) \times P(D) \times P(E)$

$= \frac{5}{12} \times \frac{4}{11} \times \frac{3}{11} \times \frac{1}{9} \times \frac{1}{8}$

$= \frac{1}{792}$

15. A bag contains 3 white, 2 black and 4 red balls. Two balls are drawn, the first replaced before the second is drawn, what is the probability that
    i. They will be of same colour?
    ii. They will be of different colour?

Solution: We have,

No. of white balls = 3

No. of black balls = 2

No. of red balls = 4

Total no. of balls = 9

Let P(W) = Probability of getting a white ball $= \frac{3}{9} = \frac{1}{3}$

P(B) = Probability of getting black ball $= \frac{2}{9}$

P(R) = Probability of getting red ball $= \frac{4}{9}$

a. P(They will be of same colour) = P(WW or BB or RR)

$= P(WW) + P(BB) + P(RR)$

$= P(W) \times P(W) + P(B) \times P(B) + P(R) \times P(R)$

$= \frac{1}{3} \times \frac{1}{3} + \frac{2}{9} \times \frac{2}{9} + \frac{4}{9} \times \frac{4}{9}$

$= \frac{29}{81}$

b. Probability of getting different colours, there should be either WB or BW or BR or RB or WR or RW

$\therefore$ P(That they are of different colour)

= P(WB or BW or BR or RB or WR or RW)

$= P(W) \times P(B) + P(B) \times P(W) + P(B) \times P(R) + P(W) \times P(R) + P(R) \times P(W)$

$= \frac{1}{3} \times \frac{2}{9} + \frac{2}{9} \times \frac{1}{3} + \frac{2}{9} \times \frac{4}{9} + \frac{4}{9} \times \frac{2}{9} + \frac{1}{3} \times \frac{4}{9} + \frac{4}{9} \times \frac{1}{3}$

$= \frac{52}{81}$

Exercise 14.2

1. We have, mean = np = 25 ... ... (i)
   Variance = npq = 5 ... ... (ii)
   from (i) and (ii)
   25q = 5

   or, $q = \frac{5}{25} = \frac{1}{5}$

   $\therefore$ $p = 1 - q = 1 - \frac{1}{5} = \frac{4}{5}$

   $\therefore$ from (ii), $n \cdot \frac{4}{5} \cdot \frac{1}{5} = 5$

   $\therefore$ $p = \frac{4}{5}, q = \frac{1}{5}$

2. We have,

$p = \frac{3}{5}$, $n = 50$

$\therefore \quad q = 1 - p = 1 - \frac{3}{5} = \frac{2}{5}$

$\therefore \quad \text{Mean} = np = 50 \times \frac{3}{5} = 30$

$\text{S.D} = \sqrt{npq} = \sqrt{50 \times \frac{3}{5} \times \frac{2}{5}} = 2\sqrt{3}$

3. We have, mean = np = 4 ... ... (i)
S.D. = $\sqrt{npq} = \sqrt{3}$
or, npq = 3 ... ... (ii)
$\therefore$ from (i) and (ii)
4q = 3

$\Rightarrow \quad q = \frac{3}{4}$

$\therefore \quad p = 1 - q = 1 - \frac{3}{4} = \frac{1}{4}$

$\therefore$ from (i), $n \times \frac{1}{4} = 4 \Rightarrow n = 16$

$\therefore$ Binomial distribution = $(q + p)^n = \left(\frac{3}{4} + \frac{1}{4}\right)^{16}$

4. We have,
Mean = np = 7 ... ... (i)
Variance = npq = 11 ... ... (ii)
$\therefore$ from (i) and (ii)
$7 \times q = 11$
or, $q = \frac{11}{7} = 1.57 > 1$

Since, q is probability of failture, which cannot be greater than 1. So, the given statement is not correct.

5. Here,

p = probability of getting ahead = $\frac{1}{2}$

q = probability of getting a tail = $\frac{1}{2}$

n = no. of trials = 4
p(r) = probability of r success in n trials
$= n_{c_r} p^r q^{n-r}$

a. p(2) = probability of 2 heads in 4 trials
$= 4_{c_2} \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^{4-2} = \frac{4 \times 3}{2} \cdot \frac{1}{4} \cdot \frac{1}{4} = \frac{3}{8}$

b. p(at least two heads) = p(2) + p(3) + p(4)
$= 4_{c_2}\, p^2q^2 + 4_{c_3} p^3 q + 4_{c_4}\, p^4$
$= \frac{4 \times 3}{2} \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^2 + 4\left(\frac{1}{2}\right)^3 \frac{1}{2} + 1\left(\frac{1}{2}\right)^4$
$= \frac{11}{16}$

c. Plat least one head = p(1) + p(2) + p(3) + p(4)
$= 4_{c_1}\, p1q^3 + 4_{c_2}\, p^2q^2 + 4_{c_3}\, p^3q + 4_{c_4}\, p^4$
$= 4_{c_2} \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^3 + 4_{c_2} \left(\frac{1}{2}\right)^2 \left(\frac{1}{2}\right)^2 + 4_{c_3} \left(\frac{1}{2}\right)^3 \frac{1}{2} + 1. \left(\frac{1}{2}\right)^4$
$= \frac{1}{4} + \frac{11}{16}$
$= \frac{15}{16}$

6. Let p be the probability of getting 3 or 6.

$\therefore \quad p = \frac{2}{6} = \frac{1}{3}$, $q = 1 - p = 1 - \frac{1}{3} = \frac{2}{3}$

n = no. of trials = 4

Now, probability of r success out of n trials is given by

$p(r) = n_{c_r} p^r q^{n-r} = 4_{c_r} \left(\frac{1}{3}\right)^r . \left(\frac{1}{3}\right)^{4-r} = r \frac{1}{81} 4_{c_r}$

a. Probability of getting at least one success = $p(\geq 1) = p(1) + p(2) + p(3) + p(4)$

$= 4_{c_1} p^1 q^{4-1} + 4_{c_2} p^2 q^{4-2} + 4_{c_3} p^3 p^{4-3} + 4_{c_4} p^4 q^{4-4}$

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

$= \frac{4\times 8}{81} + \frac{6\times 4}{81} + \frac{4\times 2}{81} + \frac{1}{81}$

$= \frac{65}{81}$

b. Probability of exactly two success = $p(2)$

$= 4_{c_2} p^2 q^2$

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

$= \frac{4 \times 3}{2} \times \frac{4}{81} = \frac{8}{27}$

7. Let X represents the number of diamond cards among the five cards drawn. Since the drawing off cards is with replacement, the trials are Bornouli trial.

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

$\Rightarrow \quad p = \frac{13}{52} = \frac{1}{4}$, $q = 1 - \frac{1}{4} = \frac{3}{4}$

X has a Binomial distribution with $n = 5$ and $p = \frac{1}{4}$

$\therefore \quad p(x = x) = n_{c_x} p^x q^{n-x}$, where $x = 0, 1, 2, \ldots n$

$= 5_{c_x} \left(\frac{3}{4}\right)^{5-x} \left(\frac{1}{4}\right)^x$

a. p(all 5 cards ae diamond) = $p(x = 5)$

$= 5_{c_5} \left(\frac{3}{4}\right)^0 \left(\frac{1}{4}\right)^5 = \frac{1}{1024}$

b. p(only 3 cards ae diamond) = $p(x = 3)$

$= 5_{c_3} \left(\frac{3}{4}\right)^2 \left(\frac{1}{4}\right)^3 = \frac{45}{512}$

c. p(none is spade) = $p(x = 0)$

$= 5_{c_0} \left(\frac{3}{4}\right)^5 \left(\frac{1}{4}\right)^0 = \frac{243}{1024}$

8. Let p = the event of getting a head 10 coins being tossed simultaneously is the same as one coin being tossed 10 times.

$p(x = r) = 10_{c_r} p^r.q^{n-r} = 10_{c_r} \left(\frac{1}{2}\right)^{10}$

a. p(exactly 6 heads) = $10_{c_6} \left(\frac{1}{2}\right)^{10}$

$= \frac{10!}{6!\ 4!} \times \frac{1}{1024} = \frac{105}{512}$

b. p(at least 7 heads) = p(7 heads or 8 heads or 9 heads or 10 heads)

$= 1 - [p(x = 0) + p(x = 1) + p(x = 2) + p(x = 3) + p(x = 4) + p(x = 5) + p(x = 6)] \left(\frac{1}{2}\right)^{10}$

$= 1 - (1 + 10 + 45 + 120 + 210 + 252 + 210) \frac{1}{1024}$

$= \frac{176}{1024}$

c. p(not more than 3 heads) = $p(x \le 34)$
$= p(x = 0) + p(x = 1) + p(x = 2) + p(x = 3)$
$= (10_{c0} + 10_{c1} + 10_{c2} + 10_{c3}).\left(\frac{1}{2}\right)^{10}$
$= (1 + 10 + 45 + 120)\ .\ \frac{1}{1024} = \frac{11}{64}$

9. Given,
Probability of getting a six in one thrown (p) $= \frac{1}{6}$
$\therefore \quad q = 1 - p = \frac{5}{6}$
No. of trials (n) = 4
Now, probability of r success in 4 trials is given by
$p(r) = n_{c_r}\ p^r.q^{n-r} = 4_{c_r}\left(\frac{1}{6}\right)^r.\left(\frac{5}{6}\right)^{4-r}$ ... ... (i)

a. $p(\text{no six}) = p(0) = 4_{c0}\left(\frac{1}{6}\right)^0\left(\frac{1}{6}\right)^{4-0} = \frac{625}{1296}$

b. $p(\text{exactly 1 six}) = p(1) = 4_{cx}\left(\frac{1}{6}\right)^1\left(\frac{5}{6}\right)^{4-1} = \frac{125}{324}$

c. $p(\text{exactly two sixes}) = p(2) = 4_{c2}\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^{4-2} = \frac{25}{216}$

10. Probability of fail $= \frac{40}{100} = \frac{2}{5} = q$
Probability of pass $= 1 - \frac{2}{5} = \frac{3}{5} = p$
$n = 6,\ q = \frac{2}{5}$
$x \to$ R.V.
We have Binomial condition,
$P(x = r) = n_{c_r}\ p^r.q^{n-r}$
$p(x \ge 4) = ?$
$\therefore \quad p(x \ge 4) = p(x = 4) + p(x = 5) + p(x = 6)$
$= 6_{c_4}\left(\frac{3}{4}\right)^4\left(\frac{2}{5}\right)^4 + 6_{c5}\left(\frac{3}{5}\right)^5\left(\frac{2}{5}\right) + 6_{c6}\left(\frac{3}{5}\right)^6\left(\frac{2}{5}\right)^0$
$= \frac{6!}{4!\ 2!} \times \frac{3^4 \times 2^2}{5^6} + \frac{6!}{5!1!} \times \frac{3^5 \times 2}{5^6} + \frac{6!}{6!} \times \frac{3^6}{5^6}$
$= \frac{1701}{3125}$

11. Given,
$p = 60\% = \frac{60}{100} = \frac{3}{5}$
$\therefore \quad q = -1 - P = 1 - \frac{3}{5} = \frac{2}{5}$
n = number of trials = 10
Now, probability of r successes in 10 trials is given by
$p(r) = 10_{c_r}\ p^r.q^{10-r} = 10_{c_r}\left(\frac{3}{5}\right)^r\left(\frac{2}{5}\right)^{10-r}$

a. P(None of them male) = p(0)
$= 10_{c0}\left(\frac{3}{5}\right)^0\left(\frac{2}{5}\right)^{10-r}$
$= \frac{10!}{0!\ 10!} \times 1 \times \frac{2^{10}}{5^{10}} = 0.0001049$

b. $P(\text{Exactly three male}) = p(3) = 10_{c3}\left(\frac{3}{5}\right)^3\left(\frac{2}{5}\right)^{10-3}$

$= \frac{10!}{7!\ 3!} \times \frac{3^3 \times 2^7}{5^3 \times 5^7} = 0.04246$

c. P(More than 4 are male) = P(r > 4)

$= p(5) + p(6) + p(7) + p(8) + p(9) + p(10)$

$= 10_{c5}\left(\frac{3}{5}\right)^5\left(\frac{2}{5}\right)^{10-5} + 10_{c6}\left(\frac{3}{5}\right)^6\left(\frac{2}{5}\right)^{10-6} + 10_{c7}\left(\frac{3}{5}\right)^7\left(\frac{2}{5}\right)^{10-7}$

$+ 10_{c8}\left(\frac{3}{5}\right)^8\left(\frac{2}{5}\right)^{10-8} + 10_{c9}\left(\frac{3}{5}\right)^9\left(\frac{2}{5}\right)^{10-9} + 10_{c10}\left(\frac{3}{5}\right)^{10}\left(\frac{2}{5}\right)^0$

$= \frac{10!}{5!\ 5!}\left(\frac{3}{5}\right)^5\left(\frac{2}{5}\right)^5 + \frac{10!}{6!\ 4!}\left(\frac{3}{5}\right)^9 + \frac{10!}{3!\ 7!}\left(\frac{3}{5}\right)^7\left(\frac{2}{5}\right)^3 + \frac{10!}{8!\ 2!}\left(\frac{3}{5}\right)^8\left(\frac{2}{5}\right)^2$

$+ \frac{10!}{9!\ 1!}\left(\frac{3}{5}\right)^9\left(\frac{2}{5}\right) + \frac{10!}{10!}\left(\frac{3}{5}\right)^{10} = 0.9447$

12. Here,

p = Probability off hitting a target $= \frac{1}{5}$

$q = 1 - p = 1 - \frac{1}{5} = \frac{4}{5}$

n = No. of hitting = 6

p(r) = Probability of r successful hitting $= n_{c_r}\ p^r q^{n-r}$

a. p(Exactly once) = p(1) = ?

$= 6_{c1}\left(\frac{1}{5}\right)^1\left(\frac{4}{5}\right)^{6-1} = \frac{6!}{5!\ 1!} \times \frac{1}{5} \times \left(\frac{4}{5}\right)^5 = 0.3932$

b. p(Exactly twice) = p(2)

$= 6_{c2}\left(\frac{1}{5}\right)^2\left(\frac{4}{5}\right)^{6-2} = \frac{6!}{4!\ 2!} \times \left(\frac{1}{5}\right)^2 \times \left(\frac{4}{5}\right)^4 = 0.24576$

13. Given,

p = Probability that a bomb dropped $= \frac{1}{4}$

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

n = no. of dropped = 5

a. P(None will strike target) = p(0) $= n_{c_r}\ p^r q^{n-r}$

$= 5_{c0}\left(\frac{1}{4}\right)^0\left(\frac{3}{4}\right)^{5-3}$

$= \frac{5!}{2!\ 3!} \times \left(\frac{1}{4}\right)^3\left(\frac{3}{4}\right)^2 = 0.879$

c. p(At least three will strike target) $= p(x \le 3)$

$= p(3) + p(4) + p(5)$

$= 5_{c3}\left(\frac{1}{4}\right)^3 . \left(\frac{3}{4}\right)^{5-3} + 5_{c4}\left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right)^{5-4} \times 5_{c5}\left(\frac{1}{4}\right)^5$

$= 5_{c3}\left(\frac{1}{4}\right)^3 . \left(\frac{3}{4}\right)^2 + \frac{5!}{4!\ 1!} \times \left(\frac{1}{4}\right)^4\left(\frac{3}{4}\right)^1 + \frac{5!}{5!}\left(\frac{1}{4}\right)^5$

$= 0.1035$

14. Given,

p = detective products = 20% $= \frac{20}{100} = \frac{!}{5}$

$q = 1 - p = 1 - \frac{1}{5} = \frac{4}{5}$, n = 4

Now, the probability of r defective in 4 trials is given by

$p(r) = 4_{c_r}\ p^r.q^{4-r} = 4_{c_r}\left(\frac{1}{5}\right)^r\left(\frac{4}{5}\right)^{4-r}$

a. p(No chip is defective) = p(0)

$= 4_{c0}\left(\frac{1}{5}\right)^0\left(\frac{4}{5}\right)^{4-0}$

$= \frac{4!}{4!\ 0!} \times 1 \times \left(\frac{4}{5}\right)^4 = 0.4096$

b. p(One chip is defective) = p(1)

$= 4_{c_1} \left(\frac{1}{5}\right)^1 \left(\frac{4}{5}\right)^{4-1}$

$= \frac{4!}{1!\ 3!} \times \frac{1}{5} \times \left(\frac{4}{5}\right)^3 = \frac{4 \times 4 \times 4 \times 4}{5 \times 5 \times 5 \times 5} = 0.4096$

c. p(more than one chip care defective)

= p(2) + p(3) + p(4)

$= 4_{c_2} \left(\frac{1}{5}\right)^2 \left(\frac{4}{5}\right)^{4-2} + 4_{c_3} \left(\frac{1}{5}\right)^3 \left(\frac{4}{5}\right)^{4-3} + 4_{c_4} \left(\frac{1}{5}\right)^4$

$= \frac{4!}{2!\ 2!} \left(\frac{1}{5}\right)^2 \left(\frac{4}{5}\right)^2 + \frac{4!}{3!\ 1!} \times \left(\frac{1}{5}\right)^3 \left(\frac{4}{5}\right) + \frac{4!}{4!} \left(\frac{1}{5}\right)^4 = 0.1808$