Chapter – 15
Probability

Notes :

$$P(E) = \frac{\text{No. of favourable outcomes}}{\text{Total no. of possible outcomes}}$$

* An action or operation resulting in a well defined outcome is called an Experiment.
* The process of conducting the experiment is called trail, whereas the outcomes is called an event.
* If an experiment can result in two or more outcomes, it is called a Random Experiment.
* The set of all possible outcomes of an experiment is called Sample Space and denoted by 'S'
* An event for an experiment is the collection of some favourable outcomes of the experiment.

* The probability of an event lies between '0' and '1'.
* The sum of all probability in an experiment is '1'
* Probability of an event is never Negative.
* $P(E) + P(\text{NOT } E) = 1$

  (ie) $P(E) + P(\bar{E}) = 1$

  (or)

  $P(A) + P(\bar{A}) = 1$
* Probability of a sure event is always 1.
* Probability of an impossible event is always 0
* $0 \leq P(E) \leq 1$
* If a die is thrown 'n' times then the total no. of outcomes are 6^n.
* If a coin is thrown 'n' times then the total no. of outcomes are 2^n
* If 2 events have the same probability, these events are said to be Equally likely events.

* The possible outcomes :

S → Sample Space.

⇒ When a die is rolled :

$S = \{1, 2, 3, 4, 5, 6\}$

$\therefore n(S) = 6$

$(ie)\ n(S) = 6^n$

$\Rightarrow 6^1 = 6$

⇒ When 2 dice are rolled :

$S = \{(1,1)\ (1,2)\ (1,3)\ (1,4)\ (1,5)\ (1,6)$

$(2,1)\ (2,2)\ (2,3)\ (2,4)\ (2,5)\ (2,6)$

$(3,1)\ (3,2)\ (3,3)\ (3,4)\ (3,5)\ (3,6)$

$(4,1)\ (4,2)\ (4,3)\ (4,4)\ (4,5)\ (4,6)$

$(5,1)\ (5,2)\ (5,3)\ (5,4)\ (5,5)\ (5,6)$

$(6,1)\ (6,2)\ (6,3)\ (6,4)\ (6,5)\ (6,6)\}$

$\therefore n(S) = 36$

$(ie)\ n(S) = 6^2 = 36$

⇒ When a coin is tossed,

$S = \{H, T\}$

$\therefore n(S) = 2$

$(ie)\ n(S) = 2^n$

$\Rightarrow 2^1 = 2$

⇒ When 2 coins are tossed,

$S = \{(H,H)\ (H,T)\ (T,H)\ (T,T)\}$

$\therefore n(S) = 4$

$(ie)\ n(S) = 2^2 = 4$

Date:

⇒ When 3 coins are tossed,

$S = \{(H,H,H), (T,T,T), (H,H,T), (T,H,H), (T,T,H), (H,T,T), (H,T,H), (T,H,T)\}$

$\therefore n(S) = 8$

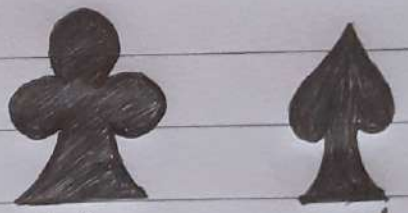
(ie) $n(S) = 2^n$

$= 2^3 = 8$

⇒ Cards @ Probability:

Cards (52)

(13) (13)



(13) (13)

The thirteen cards are named as,

A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q and K

Face cards or Picture cards:

4 Kings + 4 Queens + 4 Jack = **12**

Honour Cards:

4 Kings + 4 Queens + 4 Jack + 4 Ace = **16**

Mathematics

(Chapter – 15) (Statistics)

(Class – IX)

EXERCISE 15.1

Q.1. *In a cricket match, a batswoman hits a boundary* 6 *times out of* 30 *balls she plays. Find the probability that she did not hit a boundary.*

Sol. Total number of balls played by the batswoman = 30, Boundaries hit = 6

No. of balls in which she did not hit any boundary = 30 – 6 = 24

$$\therefore \text{P (she did not hit a boundary)} = \frac{\text{No. of balls in which she did not hit any boundary}}{\text{Total number of balls played}} = \frac{24}{30} = \frac{4}{5}$$

Q.2. 1500 *families with* 2 *children were selected randomly, and the following data were recorded. :*

Number of girls in a family	2	1	0
Number of families	475	814	211

Compute the probability of a family, chosen at random, having
(i) 2 *girls* *(ii)* 1 *girl* *(iii) No girl*
Also check whether the sum of these probabilities is 1.

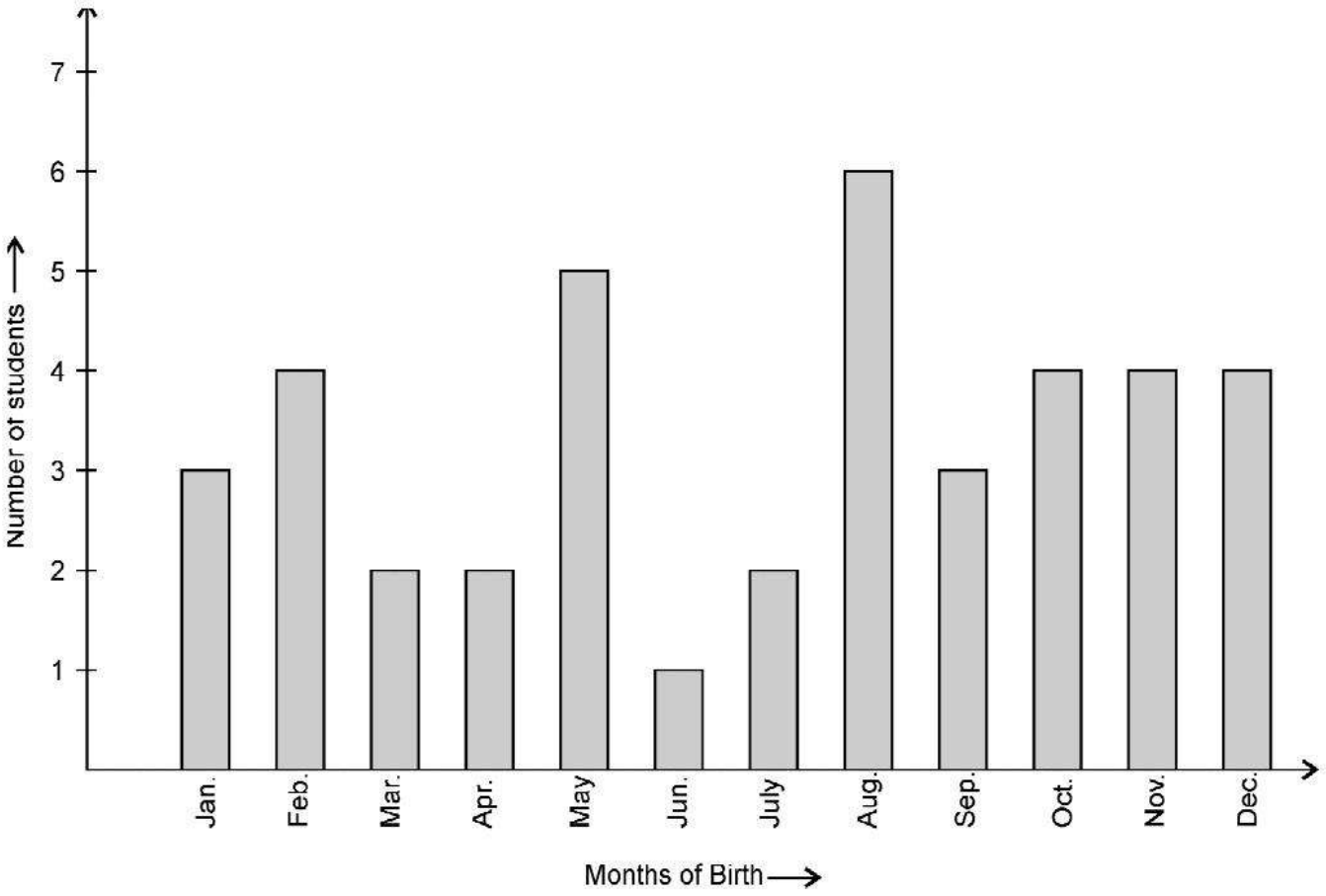
Sol. (i) $\text{P (a family having 2 girls)} = \frac{\text{No. of families having 2 girls}}{\text{Total no. of families}} = \frac{475}{1500} = \frac{19}{60}$

(ii) $\text{P (a family having 1 girl)} = \frac{\text{No. of families having 1 girl}}{\text{Total no. of families}} = \frac{814}{1500} = \frac{407}{750}$

(iii) $\text{P (a family having no girl)} = \frac{\text{No. of families having no girl}}{\text{Total no. of families}} = \frac{211}{1500}$

$$\text{Sum of the probabilities in all three cases} = \frac{19}{60} + \frac{407}{750} + \frac{211}{1500} = \frac{475 + 814 + 211}{1500} = \frac{1500}{1500} = 1$$

Q.3. *In a particular section of Class IX,* 40 *students were asked about the months of their birth and the following graph was prepared for the data so obtained. Find the probability that a student of the class was born in August.*



Sol. Total number of students considered = 40

No. of students born in August = 6

$$\therefore \text{P (a student was born in August)} = \frac{\text{No. of students born in August}}{\text{Total no. of students considered}} = \frac{6}{40} = \frac{3}{20}$$

Q.4. *Three coins are tossed simultaneously* 200 *times with the following frequencies of different outcomes :*

Outcome	*3 heads*	*2 heads*	*1 head*	*No head*
Frequency	23	72	77	28

If the three coins are simultaneously tossed again, compute the probability of 2 *heads coming up.*

Sol. Total number of tosses = 200
No. of times 2 heads occur = 72

$\therefore$ P (2 heads coming up) = $\frac{\text{No. of times 2 heads occur}}{\text{Total no. of tosses}} = \frac{72}{200} = \frac{9}{25}$

Q.5. *An organisation selected* 2400 *families at random and surveyed them to determine a relationship between income level and the number of vehicles in a family. The information gathered is listed in the table below :*

Monthly income in (Rs)	***Vehicles per family***			
	0	**1**	**2**	***Above* 2**
Less than 7000	10	160	25	0
7000 – 10000	0	305	27	2
10000 – 13000	1	535	29	1
13000 – 16000	2	469	59	25
16000 or more	1	579	82	88

Suppose a family is chosen. Find the probability that the family chosen is

(i) earning Rs 10000 – 13000 *per month and owning exactly* 2 *vehicles.*

(ii) earning Rs 16000 *or more per month and owning exactly* 1 *vehicle.*

(iii) earning less than Rs 7000 *per month and does not own any vehicle.*

(iv) earning Rs 13000 – 16000 *per month and owning more than* 2 *vehicles.*

(v) owning not more than 1 *vehicle.*

Sol. Total no. of families considered = 2400

(i) P(a family earning Rs 10000 – 13000 per month and owning exactly 2 vehicles)

$= \frac{\text{No. of families earning Rs 10000 – 13000 per month and owning 2 vehicles}}{\text{Total no. of families}} = \frac{29}{2400}$

(ii) P (a family earning Rs 16000 or more per month and owning exactly 1 vehicle)

$= \frac{\text{No. of families earning Rs 16000 or more per month and owning 1 vehicle}}{\text{Total no. of families}} = \frac{579}{2400} = \frac{193}{800}$

(iii) P(a family earning less than Rs 7000 per month and does not own any vehicle)

$= \frac{\text{No. of families earning less than Rs 7000 per month and does not own any vehicle}}{\text{Total no. of families}}$

$= \frac{10}{2400} = \frac{1}{240}$

(iv) P(a family earning Rs 13000 – 16000 per month and owing more than 2 vehicles)

$= \frac{\text{No. of families earning Rs 13000 – 16000 per month and owning more than 2 vehicles}}{\text{Total no. of families}}$

$= \frac{25}{2400} = \frac{1}{96}$

(v) P (a family owning 0 vehicle or 1 vehicle)

= P (a family not owning more than 1 vehicle)

$$= \frac{10 + 0 + 1 + 2 + 1 + 160 + 305 + 535 + 469 + 579}{2400} = \frac{2062}{2400} = \frac{1031}{1200}$$

Q.6. *Following table shows the performance of two sections of students in Mathematics test of* 100 *marks.*

Marks	***Number of students***
0 - 20	7
20 - 30	10
30 - 40	10
40 - 50	20
50 - 60	20
60 - 70	15
70 - above	8
Total	**90**

(i) Find the probability that a student obtained less than 20% *in the mathematics test.*

(ii) Find the probability that a student obtained marks 60 *or above.*

Sol. (i) Total no. of students = 90

$$\text{P (a student obtained less than 20\%)} = \frac{\text{No. of students who obtained less than 20\%}}{\text{Total no. of students}}$$

$$= \frac{7}{90}$$

(ii) P (a student obtained 60 marks or above)

$$= \frac{\text{No. of students who obtained 60 marks or more}}{\text{Total number of students}} = \frac{15 + 8}{90} = \frac{23}{90}$$

Q.7. *To know the opinion of the students about the subject statistics, a survey of* 200 *students was conducted. The data is recorded in the following table.*

Opinion	***Number of students***
like	135
dislike	65

Find the probability that a student chosen at random

(i) likes statistics, *(ii) does not like it.*

Sol. (i) $\text{P (a student likes statistics)} = \frac{\text{No. of students who like statistics}}{\text{Total no. of students}} = \frac{135}{200} = \frac{27}{40}$

(ii) P (a student does not like statistics) $= \frac{\text{No. of students who do not like statistics}}{\text{Total no. of students}}$

$= \frac{65}{200} = \frac{13}{40}$

Q.8. *The distance (in km) of* 40 *engineers from their residence to their place of work were found as follows :*

5	3	10	2	25	11	13	7	12	31
19	10	12	17	18	11	32	17	16	2
7	9	7	8	3	5	12	15	18	3
12	14	2	9	6	15	15	7	6	12

What is the empirical probability that an engineer lives :

(i) less than 7 *km from her place of work?*

(ii) more than or equal to 7 *km from her place of work?*

(iii) within $\frac{1}{2}$ *km from her place of work?*

Sol. Total no. of engineers = 40

Let us arrange the data in ascending order as follows :

2, 2, 3, 3, 3, 5, 5, 6, 6, 7, 7, 7, 7, 8, 9, 9, 10, 10, 11, 11, 12, 12, 12, 12, 12, 13, 14, 15, 15, 15, 16, 17, 17, 18, 18, 19, 20, 25, 31, 32.

(i) P (an engineer lives less than 7 km from her place of work)

$= \frac{\text{No. of engineers who live less than 7 km from their place of work}}{\text{Total no. of engineers}} = \frac{9}{40}$

(ii) P (an engineer lives more than or equal to 7 km from her work place)

$= \frac{\text{No. of engineers who live more than or equal to 7 km from their work place}}{\text{Total no. of engineers}} = \frac{31}{40}$

(iii) P (an engineer lives within $\frac{1}{2}$ km from her place of work)

$= \frac{\text{No. of engineers who live within } \frac{1}{2} \text{ km from their place of work}}{\text{Total no. of engineers}} = \frac{0}{40} = 0$

Questions 9 and 10 are activities, so students should perform these activities on their own.

Q.11. *Eleven bags of wheat flour, each marked* 5 *kg, actually contained the following weights of flour (in kg) :*

4.97 5.05 5.08 5.03 5.00 5.06 5.08 4.98 5.04 5.07 5.00

Find the probability that any of these bags chosen at random contains moer than 5 *kg of flour.*

Sol. Total no. of bags examined = 11

P (a bag weighing more than 5 kg) $= \frac{\text{No. of bags which weigh more than 5 kg}}{\text{Total no. of bags}} = \frac{7}{11}$

Q.12. *A study was conducted to find out the concentration of sulphur dioxide in the air parts per million (ppm) of a certain city. The data obtained for* 30 *days is as follows :*

0.03	0.08	0.08	0.09	0.04	0.17
0.16	0.05	0.02	0.06	0.18	0.20
0.11	0.08	0.12	0.13	0.22	0.07
0.08	0.01	0.10	0.06	0.09	0.18
0.11	0.07	0.05	0.07	0.01	0.04

Using this table, find the probability of the concentration of sulphur dioxide in the interval 0.12 – 0.16 *on any of these days.*

Sol. Total no. of days = 30

P(concentration of sulphur dioxide in the interval 0.12 – 0.16 in a day)

$$= \frac{\text{No. of days on which the concentration was in the interval } 0.12 - 0.16}{\text{Total no. of days}} = \frac{2}{30} = \frac{1}{15}$$

Q.13. *The blood groups of 30 students of Class VIII are recorded as follows :*

A, B, O, O, AB, O, A, O, B, A, O, B, A, O, O, A, AB, O, A, A, O, O, AB, B, A, O, B, A, B, O

Use this table to determine the probability that a student of this class, selected at random, has blood group AB.

Sol. Total no. of students = 30

$$\text{P (a student has blood group AB)} = \frac{\text{No. of students which have the blood group AB}}{\text{Total no. of students}}$$

$$= \frac{3}{30} = \frac{1}{10}$$