15 Probability

Lesson at a Glance

1. The experimental probability of an event E is written as P(E).
2. $P(E) = \dfrac{\text{Number of trials in which E has happened}}{\text{Total number of trials}}$.
3. The probability of a sure event is 1.
4. The probability of an impossible event is 0.
5. The probability of an event lies between 0 and 1 (both included).
6. On throwing a coin, the probability of getting a head is $\frac{1}{2}$.

TEXTBOOK QUESTIONS SOLVED

Exercise 15.1 *(Pages – 283-285)*

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 = 30.

Number of hitting the boundary = 6.

Number of balls when boundary is not hit = 30 – 6 = 24.

Probability that she did not hit the boundary $= \frac{24}{30} = \frac{4}{5}$.

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. Total number of families = 475 + 814 + 211 = 1500.

(*i*) Probability of a families having 2 girls.

$$= \frac{\text{Number of families having 2 girls}}{\text{Total number of families}}$$

$$= \frac{475}{1500} = \frac{19}{60}.$$

(*ii*) Probability of a families having 1 girl

$$= \frac{\text{Number of families having 1 girl}}{\text{Total number of families}}$$

$$= \frac{814}{1500} = \frac{407}{750}.$$

(*iii*) Probability of family having no girl

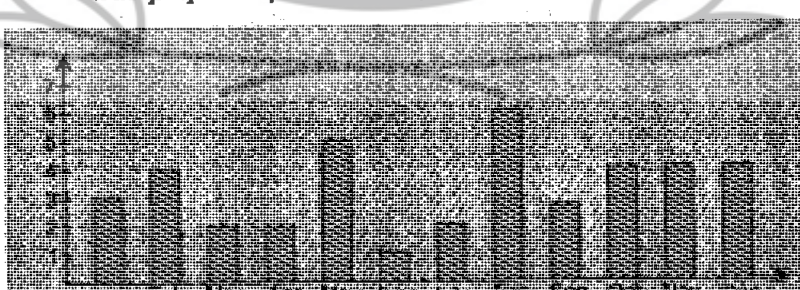
$$= \frac{\text{Number of families having no girl}}{\text{Total number of families}} = \frac{211}{1500}.$$

$$\text{Sum of the probability} = \frac{475}{1500} + \frac{814}{1500} + \frac{211}{1500}$$

$$= \frac{475 + 814 + 211}{1500} = \frac{1500}{1500} = 1$$

Clearly, the sum of the three probabilities is 1.

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:*



Observe the bar graph given above and then find the probability that a student of the class was born in August.

Sol. Total number of students in the class = 40.

Number of students born in August = 6.

$\therefore$ Probability that a student was born in August $= \frac{6}{40}$

$= \frac{3}{20}.$

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. Number of outcomes for 2 heads in 200 throws of three coins = 72.

$\therefore$ Probability of 2 heads coming up $= \frac{72}{200} = \frac{9}{25}.$

If the three coins are simultaneously tossed again, then the probability will be the same.

Hence, the required probability is $\frac{9}{25}$.

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	*Vehicles per family*			
(in ₹)	*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 ₹ 10000-13000 per month and owning exactly 2 vehicles.*

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

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

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

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

Sol. Total number of families = 2400.

(*i*) From the table, we notice there are 29 families using exactly 2 vehicles in monthly income group ₹ (10000-13000).

$\therefore$ Required probability = $\dfrac{29}{2400}$.

(*ii*) From the table, we notice there are 579 families owning exactly 1 vehicle in monthly income group ₹ 16000 and more.

$\therefore$ Required probability that a family owning exactly 1 vehicle = $\dfrac{579}{2400}$.

(*iii*) Probability that a family not owning a vehicle and earning less than ₹ 7000 per month = $\dfrac{10}{2400}$

$= \dfrac{1}{240}$.

(*iv*) Probability that a family owning more than 2 vehicles and earning ₹ (13000-16000) a month = $\dfrac{25}{2400}$

$= \dfrac{1}{96}$.

(*v*) Total number of families not owning more than 1 vehicle = 2062.

∴ Probability that a family not owning more than 1 vehicle $= \frac{2062}{2400} = \frac{1031}{1200}$.

6. *A teacher wanted to analyse the performance of two sections of students in Mathematics out of 100 marks. Looking at their performances, she found that a few students got under 20 marks and a few got 70 marks or above. So she decided to group them into intervals of varying sizes as follows: 0-20, 20-30, ..., 60-70, 70-100. Then she formed the following table:*

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*) From the table, we notice that there are 7 students, obtaining less than 20%, out of 90 students.

∴ Probability that a student obtaining less than 20% $= \frac{7}{90}$.

(*ii*) From the table, we notice that there are 15 + 8 = 23 students, obtaining 60% or more, out of 90 students.

∴ Probability that a student obtaining 60% or more

$= \frac{23}{90}$.

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*) Probability that a student likes statistics

$$= \frac{\text{Number of students who like statistics}}{\text{Total number of students}}$$

$$= \frac{135}{200} = \frac{27}{40}.$$

(*ii*) Probability that a student does not like statistics

$$= \frac{\text{Number of students who do not like statistics}}{\text{Total number of students}}$$

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

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

5	*3*	*10*	*20*	*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 number of engineers = 40.

(*i*) Number of engineers having distance of less than 7 km from their residence to the place of work = 9.

∴ Probability that an engineer lives less than 7 km from her place of work = $\frac{9}{40}$.

(*ii*) Number of engineers having distance of more than or equal to 7 km from their residence to the place of work = 40 − 9 = 31.

∴ Probability that an engineer lives more than or equal to 7 km from her place of work = $\frac{31}{40}$.

(*iii*) There is no engineer within $\frac{1}{2}$ km from her place of work.

∴ Probability that an engineer lives within $\frac{1}{2}$ km from her place of work = 0.

9. *Activity: Note the frequency of two-wheelers, three-wheelers and four-wheelers going past during a time interval, in front of your school gate. Find the probability that any one vehicle out of the total vehicles you have observed is a two-wheeler.*

Sol. Let the vehicles and their frequencies during a particular time interval going past are listed in the following table:

Vehicles	Frequency
Two-Wheeler	a
Three-wheeler	b
Four-wheeler	c

Total number of vehicles = $a + b + c$

Number of two-wheelers = a

The probability that two-wheeler is observed

$$= \frac{\text{Number of two-wheelers}}{\text{Total number of vehicles}} = \frac{a}{a+b+c}.$$

10. *Activity: Ask all the students in your class to write a 3-digit number in order. Choose any student from the* *room at random. What is the probability that the number written by her/him is divisible by 3? Remember that a number is divisible by 3, if the sum of its digits is divisible by 3.*

Sol. We know that there is one number among three consecutive positive integers is divisible by 3. Hence, about one third of the students of the class would write the numbers divisible by 3.

Hence, the required probability is $\frac{1}{3}$.

Note: Here we are assuming number of students in class is a multiple of 3.

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 more than 5 kg of flour.

Sol. Total number of bags is 11.

Number of bags containing flour (in kg) more than 5 kg is 7, *i.e.,* 5.05, 5.08, 5.03, 5.06, 5.08, 5.04, 5.07.

$\therefore$ Probability that a bag chosen at random contains more than 5 kg of flour $= \frac{7}{11}$.

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

Concentration of sulphur dioxide (in ppm)	*Frequency*
0.00-0.04	*4*
0.04-0.08	*9*
0.08-0.12	*9*
0.12-0.16	*2*
0.16-0.20	*4*
0.20-0.24	*2*
	Total = 30

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. From the table, we notice that on two days out of 30, the concen-tration of sulphur dioxide (in ppm) was in the interval 0.12-0.16.

∴ Probability of concentration of sulphur dioxide in the interval 0.12 – 0.16 on any day selected $= \frac{2}{30} = \frac{1}{15}$.

13. *The blood group of 30 students of Class IX are recorded. The table obtained for 30 students is as following:*

Blood group	*Number of students*
A	*9*
B	*6*
O	*12*
AB	*3*
	Total = 30

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

Sol. From the given table, we notice there are 3 students with blood group AB out of 30 students.

∴ Probability that a student selected has blood group AB

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