CHAPTER **15**

Probability

EXERCISE 15A

1. Total number of trials = 200

Let E be the event of getting a head and F be the event of getting a tail.

Then, the number of trials in which the event E happens = 88

and the number of trials in which the event F happens = 112

(i) $P(\text{getting a head}) = P(E) = \dfrac{\text{Number of trials in which the event E happens}}{\text{Total number of trials}}$

$= \dfrac{88}{200} = \dfrac{11}{25} = \mathbf{0.44}$

(ii) $P(\text{getting a tail}) = P(F) = \dfrac{\text{Number of trials in which event F happens}}{\text{Total number of trials}}$

$= \dfrac{112}{200} = \dfrac{14}{25} = \mathbf{0.56}$

2. (i) P(chosen child likes outdoor games)

$= \dfrac{\text{Number of children who like outdoor games}}{\text{Total number of children}}$

$= \dfrac{142}{200} = \dfrac{71}{100} = \mathbf{0.71}$

(ii) P(chosen child likes indoor games)

$= \dfrac{\text{Number of children who like indoor games}}{\text{Total number of children}}$

$= \dfrac{58}{200} = \dfrac{29}{100} = \mathbf{0.29}$

3. Total number of students = 45

Number of boys = 15

and Number of girls = 45 – 15 = 30

(i) P(chosen student is a boy)

$= \dfrac{\text{Number of boys}}{\text{Total number of students}} = \dfrac{15}{45} = \mathbf{\dfrac{1}{3}}$

(ii) P(chosen student is a girl) $= \dfrac{30}{45} = \mathbf{\dfrac{2}{3}}$

4. Total number of balls played = 42

Number of times the batsman hits the boundary = 6

Number of times the batsman does not hit the boundary = 42 – 6 = 36

P(batsman did not hit the boundary) $= \dfrac{36}{42} = \dfrac{6}{7}$

5. Total number of items = 365

Number of defective items = 125

Number of non-defective items = 365 – 125 = 240

(i) P(selected item is defective) $= \dfrac{125}{365} = \mathbf{\dfrac{25}{73}}$

(ii) P(selected item is non-defective) $= \dfrac{240}{365} = \mathbf{\dfrac{48}{73}}$

6. Total number of times the two coins are tossed simultaneously = 105 + 275 + 120 = 500

(i) Number of times 'two heads' turn up = 105

∴ P(two heads) $= \dfrac{105}{500} = \dfrac{21}{100} = \mathbf{0.21}$

(ii) Number of times 'one head' turn up = 275

∴ P(one head) $= \dfrac{275}{500} = \dfrac{55}{100} = \mathbf{0.55}$

(iii) Number of times 'no head' turn up = 120 times

∴ P(no head) $= \dfrac{120}{500} = \dfrac{24}{100} = \mathbf{0.24}$

7. Total number of times three coins are tossed simultaneously = 50

Number of times '2 heads' are obtained = 9

∴ P(2 heads) $= \dfrac{9}{50} = \mathbf{0.18}$

8. Total number of students = 30

(i) Number of students having blood group A = 9

∴ P(chosen student has A blood group)

$= \dfrac{9}{30} = \dfrac{3}{10} = \mathbf{0.3}$

(ii) Number of students having blood group AB = 3

∴ P(chosen student has AB blood group)

$= \dfrac{3}{30} = \dfrac{1}{10} = \mathbf{0.1}$

9. Total number of times 4 coins are tossed simultaneously = 100

(i) Number of times '2 heads' turn up = 32

P(2 heads turning up) $= \dfrac{32}{100} = \mathbf{\dfrac{8}{25}} = \mathbf{0.32}$

(ii) Number of times 'No head' turn up = 8

P(no head turning up) $= \dfrac{8}{100} = \mathbf{\dfrac{2}{25}} = \mathbf{0.08}$

10. Total number of times a die is thrown = 400

(i) Number of times 'a number less than 3' is obtained = 68 + 62 = 130

∴ P(getting 'a number less than 3') $= \dfrac{130}{400} = \mathbf{\dfrac{13}{40}}$

(ii) Number of times 'number 3' is obtained = 60.

∴ P(getting 'number 3') $= \dfrac{60}{400} = \mathbf{\dfrac{3}{20}}$

(iii) Number of times 'a number more than 3' is obtained $= 81 + 60 + 69 = 210$

$\therefore$ P(getting 'a number more than 3') $= \frac{210}{400} = \mathbf{\frac{21}{40}}$

11. Total number of times a die is thrown = 800

Number of times '1' turns up = 150

$\therefore$ P(getting '1') $= \frac{150}{800} = \mathbf{0.1875}$

Number of times '2' turns up = 120

$\therefore$ P(getting '2') $= \frac{120}{800} = \mathbf{0.15}$

Number of times '3' turns up = 144

$\therefore$ P(getting '3') $= \frac{144}{800} = \mathbf{0.18}$

Number of times '4' turns up = 140

$\therefore$ P(getting '4') $= \frac{140}{800} = \mathbf{0.175}$

Number of times '5' turns up = 126

$\therefore$ P(getting '5') $= \frac{126}{800} = \mathbf{0.1575}$

Number of times '6' turns up = 120

$\therefore$ P(getting '6') $= \frac{120}{800} = \mathbf{0.15}$

12. Total number of telephone numbers on one page of directory = 200

(i) Number of telephone numbers having 4 as the unit's digit = 14

$\therefore$ P(chosen number having 4 as the unit's digit)

$$= \frac{14}{200} = \frac{7}{100} = \mathbf{0.07}$$

(ii) Number of telephone numbers having 5 as the unit's digit = 20

$\therefore$ P(chosen number having 5 as the unit's digit)

$$= \frac{20}{200} = \frac{1}{10} = \mathbf{0.1}$$

13. Total number of families = 20

(i) Number of families having 4 members = 4

$\therefore$ P(chosen family has 4 members)

$$= \frac{4}{20} = \frac{4}{20} \times 100\% = \mathbf{20\%}$$

(ii) Number of families having 'more than 3 members'

$$= \frac{10}{20} = \frac{10}{20} \times 100\% = \mathbf{50\%}$$

14. Total number of days on which the books were issued = 7

(i) Number of days on which the books issued per day were less than 1500 = 3

$\therefore$ P(number of book issued on a day is less than 1500) $= \mathbf{\frac{3}{7}}$

(ii) Number of days on which the book issued per day were more than 1500 = 4

$\therefore$ P(number of books issued on a day is more than 1500) $= \mathbf{\frac{4}{7}}$

15. Total number of bags of seeds = 5

(i) Number of bags having more than 60 germinated seeds = 3

$\therefore$ P(germination of more than 60 seeds in a bag)

$$= \mathbf{\frac{3}{5}}$$

(ii) Number of bags having 99 seeds in a bag = 1

$\therefore$ P(germination of 99 seeds in a bag) $= \mathbf{\frac{1}{5}}$

(iii) Number of bags having more than 40 seeds in a bag = 5

$\therefore$ P(germination of more than 40 seeds in a bag)

$$= \frac{5}{5} = \mathbf{1}$$

16. Total number of times two dice are thrown simultaneously = 200

(i) Number of times when a sum of '7' appeared on the tops of dice = 32

$\therefore$ P(getting a 'sum of 7') $= \frac{32}{200} = \mathbf{\frac{4}{25}}$

(ii) Number of times when a sum 'less than or equal to 8' appeared on the tops of the dice = 150

$\therefore$ P(getting a sum 'less than or equal to 8')

$$= \frac{150}{200} = \mathbf{\frac{3}{4}}$$

17. Total number of students = 100

(i) Number of students who obtained marks in the interval 80 – 90 = 5

$\therefore$ P(students obtained marks in the interval 80 – 90)

$$= \frac{5}{100} = \mathbf{0.05}$$

(ii) Number of students who obtained marks in the interval 0 – 40 = 4 + 8 + 20 + 10 = 42

$\therefore$ P(student obtained marks in the interval 0 – 40)

$$= \frac{42}{100} = \mathbf{0.42}$$

(iii) Number of students who obtained marks in the interval 40 – 80 = 22 + 10 + 6 + 10 = 48

$\therefore$ P(student obtained marks in the interval 40 – 80)

$$= \frac{48}{100} = \mathbf{0.48}$$

18. Total number of case studies (of distance covered before a tyre needed to be replaced) = 2000

(i) Number of cases in which tyre needed to be replaced before it covered 4000 km = 40

$\therefore$ P(tyre needs to be replaced before it has covered 4000 km)

$$= \frac{40}{2000} = \frac{2}{100} = \mathbf{0.02}$$

(ii) Number of cases in which tyre needed to be replaced after the tyre had covered 9000 km = 650 + 890 = 1540

$\therefore$ P(tyre needs to be replaced after it has covered 9000 km)

$$= \frac{1540}{2000} = \frac{77}{100} = \mathbf{0.77}$$

(iii) Number of cases in which tyre needed to be replaced after it had covered a distance in the range of

4000 km to 14000 km = 420 + 650 = 1070

$\therefore$ P(tyre needs to be replaced after it has covered a distance in the range of 4000 km to 14000 km)

$$= \frac{1070}{2000} = \mathbf{0.535}$$

19. Total number of students = 40

(i) Number of students born on a Sunday = 6

$\therefore$ P(student was born on a Sunday) = $\frac{6}{40}$ = **0.15**

(ii) Number of students born on a day other than Saturday and Sunday = 28

$\therefore$ P(student was born on a day other than Saturday or Sunday) = $\frac{28}{40}$ = **0.7**

20. Total number of students = 40

(i) Number of students whose weight is almost 50 kg

= 6 + 8 + 12 + 6 = 32

P(weight of a student is at most 50 kg) = $\frac{32}{40} = \mathbf{\frac{4}{5}}$

(ii) Number of students whose weight is at least 41 kg

= 12 + 6 + 3 + 2 + 2 + 1 = 26

P(weight of a student is at least 41 kg) = $\frac{26}{40} = \mathbf{\frac{13}{20}}$

(iii) Number of students whose weight is not more than 45 kg = 6 + 8 + 12 = 26

P(weight of a student is not more than 45 kg)

$$= \frac{26}{40} = \mathbf{\frac{13}{20}}$$

CHECK YOUR UNDERSTANDING

MULTIPLE-CHOICE QUESTIONS

1. (b) **1**

Empirical probability of an event E

$$= \frac{\text{Number of trials in which event E happened}}{\text{Total number of trials}}$$

If E_1, E_2 + … + E_n are possible outcomes of a trial, then clearly

$$P(E_1) + P(E_2) + \dots + P(E_n) = \mathbf{1}$$

For example: If a coin is tossed 100 times, out of which heads turns up 45 times.

Then, P(head) = $\frac{45}{100}$ and

$$\text{P(tail)} = \frac{100 - 45}{100} = \frac{55}{100}$$

Note that P(head) + P(tail) = 1

2. (b) **1**

Empirical probability of an event E

$$= \frac{\text{Number of trials in which event E happened}}{\text{Total number of trials}}$$

Since, a sure event will happen in all the trials, so the number of trials in which a sure event happens will be equal to the total number of trials.

$\therefore$ Probability of a sure event will be $\frac{1}{1}$ = **1**

3. (d) $\mathbf{\frac{5}{4}}$

Empirical probability of an event

$$= \frac{\text{Number of trails which event E happened}}{\text{Total number of trials}}$$

Clearly, the number of trials in which E happened can never be more than the total number of trials. So, the empirical probability of an event can never be more than 1. Hence, $\frac{5}{4}$ cannot be empirical probability of an event.

4. (c) **0**

Empirical probability of an event E

$$= \frac{\text{Number of trials in which event E happened}}{\text{Total number of trials}}$$

Since, an impossible event will never happen, so the number of trials in which impossible event will happen is equal to 0.

$\therefore$ Probability of an impossible event is

$$\frac{0}{\text{Total number of trials}} = 0$$

5. (b) $\mathbf{\frac{21}{25}}$

Total number of balls played = 50

Batswoman hits the boundary 8 times

$\therefore$ Batswoman does not hit the boundary

50 – 8 = 42 times

$\therefore$ P(Batswoman did not hit a boundary)

$$= \frac{42}{50} = \mathbf{\frac{21}{25}}$$

6. (a) $\mathbf{\frac{147}{300}}$

Total number of times a die is thrown = 300

Number of times odd numbers are obtained = 153

$\therefore$ Number of times even numbers are obtained

= 300 – 153 = 147

$\therefore$ P(getting an even number) = $\frac{147}{300}$

7. (b) $\mathbf{\frac{1}{2}}$

Total number of possible outcomes

= 2 (pin up, pin down)

Thumbtack has equal chance of landing with pin up or pin down.

$\therefore$ P(pin facing up) = $\mathbf{\frac{1}{2}}$

8. (d) $\mathbf{\frac{48}{73}}$

Total number of days for which the weather forecast was made = 365

Number of days for which the weather forecast was correctly made = 125

$\therefore$ Number of days for which the weather forecast was not made correctly = 365 – 125 = 240

$\therefore$ P(on a given day weather forecast was not correct)

$= \frac{240}{365} = \mathbf{\frac{48}{73}}$

9. (c) $\mathbf{\frac{29}{50}}$

Number of times a fair coin was tossed = 100

Number of times a head occurs = 58

P(getting a head) = $\frac{58}{100} = \mathbf{\frac{29}{50}}$

10. (d) **0.34**

Total number of times two coins are tossed = 300

Number of times when either one or two heads are obtained = 198

$\therefore$ Number of times when no head is obtained

= 300 – 198 = 102

$\therefore$ P(getting no head) = $\frac{102}{300} = \frac{34}{100}$ = **0.34**

11. (a) $\mathbf{\frac{m}{n}}$

Total number of trails = n

Number of times event E happens = m

$$P(E) = \frac{\text{Number of trials in which event E happened}}{\text{Total number of trials}}$$

$= \mathbf{\frac{m}{n}}$

VALUE-BASED QUESTIONS

1. Number of college students who offered to donate blood = 30

(i) (a) Number of students whose blood group is A = 9

$\therefore$ P(chosen student has a blood group A)

$= \frac{9}{30} = \mathbf{\frac{3}{10}}$

(b) Number of students whose blood group is AB = 3

$\therefore$ P(chosen student has a blood group AB)

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

(ii) Compassion, empathy, helpfulness and responsible behaviour.

2. Total number of children = 200

(i) (a) Number of children, who like outdoor games, yoga and jogging = 142

$\therefore$ P(chosen child likes outdoor games, yoga and jogging)

$= \frac{142}{200} = \mathbf{\frac{71}{100}}$

(b) Number of children who like to watch TV = 58

$\therefore$ P(chosen child likes to watch TV)

$= \frac{58}{200} = \mathbf{\frac{29}{100}}$

(iii) Awareness about the importance of physical fitness.

UNIT TEST

1. (b) **0.37**

Total number of people under study = 500

Number of people who are computer savvy = 315

Number of people who are not computer savvy

= 500 – 315 = 185

$\therefore$ P(selected person is not computer savvy)

$= \frac{185}{500} = \frac{37}{100}$ = **0.37**

2. (c) $\mathbf{\frac{17}{20}}$

Total number of times two coins are tossed = 100

Total number of times 'at most one head' is obtained

= 52 + 33 = 58

$\therefore$ P(getting 'at most one head') = $\frac{85}{100} = \mathbf{\frac{17}{20}}$

3. (a) $\mathbf{\frac{1}{2}}$

Total number of times a die is thrown = 40

Total number of times an odd number is obtained

= 9 + 8 + 3 = 20

$\therefore$ P(getting 'an odd number') = $\frac{20}{40} = \frac{1}{2}$

4. (d) $\mathbf{\frac{2}{15}}$

Total number of telephone numbers saved in a mobile = 150

Total number of telephone numbers having digit 0 in the unit's place = 20

$\therefore$ P(chosen number 'has 0 digit in the unit's place')

$$= \frac{20}{150} = \mathbf{\frac{2}{15}}$$

5. (d) **Between 0 and 1 (both inclusive)**

$$\text{P of an event E} = \frac{\text{Number of trials in which event E happened}}{\text{Total number of trials}}$$

Clearly $0 \leq PE \leq 1$

P(impossible event) = 0 and P(sure event) = 1

$\therefore$ P(E) is always **between 0 and 1 (both inclusive).**

6. Total number of times the three coins are tossed simultaneously = 200

(i) Total number of times less than 3 heads are obtained = 56 + 84 + 40 = 180

$\therefore$ P(getting 'less than 3 heads') = $\frac{180}{200} = \mathbf{\frac{9}{10}}$

(ii) Total number of times 2 heads are obtained = 56

$\therefore$ P(getting '2 heads') = $\frac{56}{200} = \mathbf{\frac{7}{25}}$

(iii) Total number of times at most 1 head is obtained = 84 + 40 = 124

$\therefore$ P(getting 'at most 1 head') = $\frac{124}{200} = \mathbf{\frac{31}{50}}$

7. Total number of teachers = 10 + 25 + 45 + 18 + 2 = 100

(i) Total number of teachers less than 50 years age = 10 + 25 + 45 = 80

$\therefore$ P(selected teacher's age in 'less than 50 years')

$$= \frac{80}{100} = \mathbf{\frac{4}{5}}$$

(ii) Total number of teachers whose age in years is less than 40 but more than 29 = 25

$\therefore$ P(selected teacher's age in years is 'less than 40 but more than 29') = $\frac{25}{100} = \mathbf{\frac{1}{4}}$

(iii) Total number of teachers whose age in year is over 49 but under 60 = 18

$\therefore$ P(selected teacher's age in years is 'over 48 but under 60) = $\frac{18}{100} = \mathbf{\frac{9}{50}}$

8. Total number of families with two children = 1000

(i) Number of families with 2 boys = 305

$\therefore$ P(chosen family has 2 boys) = $\frac{305}{1000} = \mathbf{\frac{61}{200}}$

(ii) Number of families with at least one boy = 270 + 305 = 575

$\therefore$ P(chosen family has at least 1 boy) = $\frac{575}{1000} = \mathbf{\frac{23}{40}}$

(iii) Number of families with at most 1 boy = 425 + 270 = 695

$\therefore$ P(chosen family has at most 1 boy)

$$= \frac{695}{1000} = \mathbf{\frac{139}{200}}$$

9. Total number of students = 100

(i) Number of students who got less than 70% marks = (2 + 9 + 11 + 22 + 26 + 18) = 88

$\therefore$ P(chosen student gets 'less than 70% marks')

$$= \frac{88}{100} = \mathbf{\frac{22}{25}}$$

(ii) Number of students who got 60% or more marks = 18 + 12 = 30

$\therefore$ P(chosen student gets '60% or more marks')

$$= \frac{30}{100} = \mathbf{\frac{3}{10}}$$

(iii) Number of students who got more than or equal to 30% marks but less than 50% marks = 11 + 22 = 33

$\therefore$ P(chosen student gets 'more than or equal to 30% marks but less than 50% marks') = $\mathbf{\frac{33}{100}}$

10. Total number of students = 50

(i) Number of students who put in 2 or more hours for studying = 9 + 18 + 10 + 5 = 42

$\therefore$ P(selected student spent '2 or more hours' for studying) = $\frac{42}{50} = \mathbf{\frac{21}{25}}$

(ii) Number of students who put in more than 1 but less than 4 hours for studying = 9 + 18 = 27

$\therefore$ P(selected student spent 'more than 1 but less than 4 hours' for studying) = $\mathbf{\frac{27}{50}}$

(iii) Number of students who put in less than 3 hours for studying = 8 + 9 = 17

$\therefore$ P(selected student spent 'less than 3 hours for studying') = $\mathbf{\frac{17}{50}}$