SAMPLE SPACE AND EVENTS

The set S consisting of all possible outcomes of a given experiment is called the sample space.

A particular outcome is called an event and usually denoted by E.

An event is the subset of the sample space S.

PROBABILITY OF AN EVENT

To find the probability of an event we use the formula

$$P(E) = \frac{n(E)}{n(S)} = \frac{\text{no. of ways in which event occurs}}{\text{no. of the elements of the sample space}}$$

Since the number of outcomes in an event is less than or equal to the number of outcomes in the sample space, the probability of an event must be a number between 0 and 1.

i.e. $0 \leq P(E) \leq 1$

PROBABILITY THAT AN EVENT DOES NOT OCCUR

The formula to find the probability that an event does not occur is given by

$$P(\bar{E}) = 1 - P(E)$$

EXERCISE 7.5

For the following experiments, find the probability in each case:

Q.1 Experiment:

From a box containing orange flavoured sweets, Bilal takes out one sweet without looking

Events Happening:

(i) The sweet is orange flavoured (ii) The sweet is lemon flavoured

Solution:

As the box contain just orange flavoured sweets

$\Rightarrow$ $n(S) = 1$

(i) Let A = Event: The sweet is orange – flavoured

$\Rightarrow$ $n(A) = 1$

So $P(A) = \frac{n(A)}{n(S)} = \frac{1}{1} = 1$

(ii) Let B = Event: The sweet is lemon – flavoured

$\Rightarrow$ $n(B) = 0$

So $P(B) = \frac{n(B)}{n(S)} = \frac{0}{1} = 0$

Q.2 Experiment:

Pakistan and India play a cricket match. The result is:

Events Happening:

(i) Pakistan wins (ii) India does not lose.

Solution:

Here total possible outcomes of match are three

$\Rightarrow$ $n(S) = 3$

(i) Let

A = Event: Pakistan wins

$\Rightarrow$ $n(A) = 1$

So $P(A) = \frac{n(A)}{n(S)} = \frac{1}{3}$

(ii) Let

B = Event: India does not lose

$\Rightarrow$ $n(B) = 2$

So $P(B) = \frac{n(B)}{n(S)} = \frac{2}{3}$

Q.3 Experiment

There are 5 green and 3 red balls in a box, one ball is taken out.

Events Happening:

(i) The ball is green (ii) The ball is red.

Solution:

As there are 5 green and 3 red balls in box

$\Rightarrow$ $n(S) = 8$

(i) Let

A = Event: The ball is green.

$\Rightarrow$ $n(A) = 5$

So $P(A) = \frac{n(A)}{n(S)} = \frac{5}{8}$

(ii) Let

B = Event: The ball is red

$\Rightarrow$ $n(B) = 3$

So $P(B) = \frac{n(B)}{n(S)} = \frac{3}{8}$

Q.4 Experiment

A fair coin is tossed three times. It shows

Events Happening:

(i) one tail (ii) at least one head.

Solution:

If a fair coin is tossed three times, we get 8 outcomes such that

S = {HHH, HHT, HTH, THH, THH, TTH, THT, HTT, TTT}

(i) Let

A = Event: One tail = {HHT, HTH, THH}

$\Rightarrow$ n (A) = 3

So $P(A) = \frac{n(A)}{n(S)} = \frac{3}{8}$

(ii) Let

B = Event: at least one head = {HHH, HHT, HTH, THH, TTH, THT, HTT}

$\Rightarrow$ $P(B) = \frac{n(B)}{n(S)} = \frac{7}{8}$

Q.5 A die is rolled. The top shows

Events Happening:

(i) 3 or 4 dots (ii) dots less than 5

Solution:

As we know that a die has six faces

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

n (S) = 6

(i) Let

A = Event: 3 or 4 dots = {3, 4}

$\Rightarrow$ n (A) = 2

So $P(A) = \frac{n(A)}{n(S)} = \frac{2}{6} = \frac{1}{3}$

(ii) Let

B = Event: dots less than 5 = {1, 2, 3, 4}

$\Rightarrow$ n (B) = 4

So $P(B) = \frac{n(B)}{n(S)} = \frac{4}{6} = \frac{2}{3}$

Q.6 Experiment:

From a box containing slips numbered 1, 2, 3, 4, 5 one slip is picked up.

Event Happening:

(i) The number on the slip is a prime number

(ii) The number on the slip is a multiple of 3.

Solution:

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

$\Rightarrow$ $n(S) = 5$

(i) Let

A = Event: The number on the slip is a prime number $= \{2, 3, 5\}$

$\Rightarrow$ $n(A) = 3$

So $P(A) = \frac{n(A)}{n(S)} = \frac{3}{5}$

(ii) Let

B = Event: The number on the slip is a multiple of 3 $= \{3\}$

$\Rightarrow$ $n(B) = 1$

So $P(B) = \frac{n(B)}{n(S)} = \frac{1}{5}$

Q.7 Experiment:

Two dice, one red and the other blue, are rolled simultaneously. The number of dots on the tops are added. The total of two score is:

Events Happening:

(i) 5 (ii) 7 (iii) 11

Solution:

When two dice are rolled, the total possible outcomes are

$$S = \begin{Bmatrix} (1,1), & (1,2), & (1,3), & (1,4), & (1,5), & (1,6) \\ (2,1), & (2,2), & (2,3), & (2,4), & (2,5), & (2,6) \\ (3,1), & (3,2), & (3,3), & (3,4), & (3,5), & (3,6) \\ (4,1), & (4,2), & (4,3), & (4,4), & (4,5), & (4,6) \\ (5,1), & (5,2), & (5,3), & (5,4), & (5,5), & (5,6) \\ (6,1), & (6,2), & (6,3), & (6,4), & (6,5), & (6,6) \end{Bmatrix}$$

$\Rightarrow$ $n(S) = 36$

(i) Let

A = Event: The total of two scores is 5

$= \{(1, 4), (2, 3), (3, 2), (4, 1)\}$

$\Rightarrow$ $n(A) = 4$

So $P(A) = \frac{n(A)}{n(S)} = \frac{4}{36} = \frac{1}{9}$

(ii) Let

B = Event: The total of two scores is 7

= {(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)}

$\Rightarrow$ n (B) = 6

So $P(B) = \frac{n(B)}{n(S)} = \frac{6}{36} = \frac{1}{6}$

(iii) Let

C = Event: The total of two scores is 11

= {(5, 6), (6, 5)}

$\Rightarrow$ n (C) = 2

So $P(C) = \frac{n(C)}{n(S)} = \frac{2}{36} = \frac{1}{18}$

Q.8 Experiment:

A bag contains 40 balls out of which 5 are green, 15 are black and the remaining are yellow. A ball is taken out of the bag.

Events Happening:

(i) The ball is black (ii) The ball is green (iii) The ball is not green

Solution:

Total balls = 40

$\Rightarrow$ n (S) = 40

(i) Let

A = Event: The ball is black

$\Rightarrow$ n (A) = 15

So $P(A) = \frac{n(A)}{n(S)} = \frac{15}{40} = \frac{3}{8}$

(ii) Let

B = Event: The ball is green

$\Rightarrow$ n (B) = 5

So $P(B) = \frac{n(B)}{n(S)} = \frac{5}{40} = \frac{1}{8}$

(iii) Let

C = Event: The ball is not green

$\Rightarrow$ n (C) = 35

So $P(C) = \frac{n(C)}{n(S)} = \frac{35}{40} = \frac{7}{8}$

Q.9 Experiment:

One chit out of 30 containing the names of 30 students of a class of 18 boys and 12 girls is taken out at random, for nomination as the nominator of the class.

Events Happening:

(i) The monitor is a boy (ii) The monitor is a girl

Solution:

Total students = 30

$\Rightarrow$ n (S) = 30

(i) Let

A = Event: The monitor is a boy

$\Rightarrow$ n (A) = 18

So $P(A) = \frac{n(A)}{n(S)} = \frac{18}{30} = \frac{3}{5}$

(ii) Let

B = Event: The monitor is a girl

$\Rightarrow$ n (B) = 12

So $P(B) = \frac{n(B)}{n(S)} = \frac{12}{30} = \frac{2}{5}$

Q.10 A coin is tossed four times. The tops show

Events Happening:

(i) All heads (ii) Two heads and two tails

Solution:

If a coin is tossed four times the total number of outcomes are 16.

$\Rightarrow$ n (S) = 16

(i) Let

A = Event: The top shows all heads

= {HHHH}

$\Rightarrow$ n (A) = 1

So $P(A) = \frac{n(A)}{n(S)} = \frac{1}{16}$

(ii) Let

B = Event: The top shows 2 heads and 2 tails

= {HHTT, HTHT, THTH, THHT, HTTH, TTHH}

$\Rightarrow$ n (B) = 6

So $P(B) = \frac{n(B)}{n(S)} = \frac{6}{16} = \frac{3}{8}$