

CBSE Class-11 Mathematics
NCERT Solutions
Chapter - 16 Probability
Exercise 16.2

1. A die is rolled. Let E be the event “die shows 4” and F be the event “die shows even number”. Are E and F mutually exclusive?

Ans. When a die is rolled, then $S = \{1, 2, 3, 4, 5, 6\}$

E: die shows 4 = $\{4\}$ and F: die shows even number = $\{2, 4, 6\}$

Now, $E \cap F = \{4\} \neq \emptyset$

Therefore, E and F are not mutually exclusive events.

2. A die is thrown. Describe the following events.

(i) A: a number less than 7 (ii) B: a number greater than 7

(iii) C: a multiple of 3 (iv) D: a number less than 4

(v) E: an even number greater than 4 (vi) F: a number not less than 3

Also find $A \cup B, A \cap B, B \cup C, E \cap F, D \cap E, A - C, D - E, C \cap F', F'$

Ans. When a die is thrown, then $S = \{1, 2, 3, 4, 5, 6\}$

(i) A: a number less than 7 = $\{1, 2, 3, 4, 5, 6\}$

(ii) B: a number greater than 7 = \emptyset

(iii) C: a multiple of 3 = $\{3, 6\}$

(iv) D: a number less than 4 = $\{1, 2, 3\}$

(v) E: an even number greater than 4 = $\{6\}$

(vi) F: a number not less than 3 = $\{3, 4, 5, 6\}$

$$\therefore A \cup B = \{1, 2, 3, 4, 5, 6\}$$

$$A \cap B = \emptyset$$

$$B \cup C = \{3, 6\}$$

$$E \cap F = \{6\}$$

$$D \cap E = \emptyset$$

$$A - C = \{1, 2, 4, 5\}$$

$$D - E = \{1, 2, 3\}$$

$$E \cap F' = \emptyset$$

$$F' = \{1, 2\}$$

3. An experiment involves rolling a pair of dice and recording the numbers the numbers that come up. Describe the following events:

A: the sum is greater than 8

B: 2 occurs on either die

C: the sum is at least 7 and a multiple of 3

Which pairs of these events are mutually exclusive?

Ans. When a pair of die is rolling then

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

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

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

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

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

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

$$\mathbf{A:} \text{ the sum is greater than 8} = \{(3,6), (4,5), (4,6), (5,4), (5,5), (5,6), (6,3), (6,4), (6,5), (6,6)\}$$

$$\mathbf{B:} \text{ 2 occurs on either die} = \{(1,2), (2,1), (2,2), (2,3), (2,4), (2,5), (2,6), (3,2), (4,2), (5,2), (6,2)\}$$

C: the sum is at least 7 and a multiple of 3 = {(3, 6), (4, 5), (5, 4), (6, 3), (6, 6)}

$\therefore A \cap B = \emptyset$ therefore, A and B are mutually exclusive events.

$B \cap C = \emptyset$ therefore, B and C are mutually exclusive events.

$A \cap C = \{(3, 6), (6, 3), (5, 4), (4, 5), (6, 6)\} \neq \emptyset$

therefore, A and C are not mutually exclusive events.

4. Three coins are tossed once. Let A denotes the event “three heads show”, B denotes the event “two heads and one tail show”, C denotes the event “three tails show” and D denotes the event “a head shows on the first coin”. Which events are (i) mutually exclusive, (ii) simple, (iii) compound?

Ans. When three coins are tossed then $S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$

A: three heads shows = {HHH}

B: two heads and one tail show = {HHT, HTH, THH}

C: three tails show = {TTT}

D: a head shows on the first coin = {HHH, HHT, HTH, HTT}

(i) $A \cap B = \emptyset$ therefore, A and B are mutually exclusive events.

$B \cap C = \emptyset$ therefore, B and C are mutually exclusive events.

$A \cap C = \emptyset$ therefore, A and C are mutually exclusive events.

$D \cap C = \emptyset$ therefore, D and C are mutually exclusive events.

$A \cap D = \{HHH\} \neq \emptyset$ therefore, A and D are not mutually exclusive events.

$B \cap D = \{HHT, HTH\} \neq \emptyset$ therefore, B and D are not mutually exclusive events.

(ii) $A = \{HHH\}$, Here $n = 1$ therefore, A is a simple event.

$C = \{TTT\}$, Here $n = 1$ therefore, C is a simple event.

Therefore A and C are simple events

(iii) $B = \{HHT, HTH, THH\}$, Here $n = 3 > 1$ therefore, B is a compound event.

$D = \{HHH, HHT, HTH, HTT\}$ Here $n = 4 > 1$ therefore, B is a compound event.

Therefore B and D are compound events

5. Three coins are tossed. Describe:

(i) Two events which are mutually exclusive.

(ii) Three events which are mutually exclusive and exhaustive.

(iii) Two events, which are not mutually exclusive.

(iv) Two events which are mutually exclusive but not exhaustive.

(v) Three events which are mutually exclusive but not exhaustive.

Ans. When three coins are tossed then $S = \{HHH, HHT, HTH, THH, TTH, HTT, THT, TTT\}$

(i) A: getting at least two heads = $\{HHH, HHT, HTH, THH\}$

B: getting at least two tails = $\{HTT, THT, TTH, TTT\}$

$\therefore A \cap B = \emptyset$ therefore, A and B are mutually exclusive events.

(ii) A: getting at least two heads = $\{HHH, HHT, HTH, THH\}$

B: getting exactly one head = $\{HTT, THT, TTH\}$

C: getting no head = $\{TTT\}$

$\therefore A \cap B = \emptyset$ therefore, A and B are mutually exclusive events.

$B \cap C = \emptyset$ therefore, B and C are mutually exclusive events.

$A \cap C = \emptyset$ therefore, A and C are mutually exclusive events.

Also $A \cup B \cup C = \{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT\} = S$

Therefore, A, B, C are mutually exclusive events.

(iii) A: getting at least two heads = {HHH, HHT, HTH, THH}

B: getting exactly two heads = {HHT, HTH, THH}

$$\therefore A \cap B = \{HHT, HTH, THH\} \neq \emptyset$$

Therefore, A and B are not mutually exclusive events.

(iv) A: getting three heads = {HHH}

B: getting three tails = {TTT}

$$\therefore A \cap B = \emptyset \text{ therefore, A and B are mutually exclusive events.}$$

$A \cup B = \{HHH, TTT\} \neq S$ therefore, A and B are not exhaustive.

(v) A: getting three heads = {HHH}

B: getting exactly two heads = {HHT, HTH, THH}

C: getting three tails = {TTT}

$$\therefore A \cap B = \emptyset \text{ therefore, A and B are mutually exclusive events.}$$

$B \cap C = \emptyset$ therefore, B and C are mutually exclusive events.

$A \cap C = \emptyset$ therefore, A and C are mutually exclusive events.

Also $A \cup B \cup C = \{HHH, HHT, HTH, THH, TTT\} \neq S$

Therefore, A, B, C are not exhaustive events.

6. Two dice are thrown. The events A, B and C are as follows:

A: getting an even number on the first die

B: getting an odd number on the first die

C: getting the sum of the numbers on the dice ≤ 5

Describe the events:

(i) A'

(ii) not B

(iii) A or B

(iv) A and B

(v) A but not C

(vi) B or C

(vii) B and C

(viii) $A \cap B' \cap C'$

Ans. When two dice are thrown, then

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

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

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

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

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

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

A: getting an even number on the first die

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

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

B: getting an odd number on the first die

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

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

C: getting the sum of the number on the dice

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

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

(i) $A' = \{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6), (5, 1),$

$(5, 2), (5, 3), (5, 4), (5, 5), (5, 6)\} = B$

(ii) $\text{not } B = \{(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6), (4, 1), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6),$

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

(iii) $A \text{ or } B = \{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6)$

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

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

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

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

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

(iv) $A \text{ and } B = A \cap B = \emptyset$

(v) $A \text{ but not } C = A - C = \{(2, 4), (2, 5), (2, 6), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (6, 1), (6, 2),$

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

(vi) $B \text{ or } C = B \cup C = \{(1, 1), (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3), (3, 4), (3, 5), (3, 6), (4, 1), (5, 1), (5, 2), (5, 3), (5, 4), (5, 5), (5, 6)\}$

(vii) $B \text{ and } C = B \cap C = \{(1, 1), (1, 2), (1, 3), (1, 4), (3, 1), (3, 2)\}$

(viii) $A \cap B' \cap C' = \{(2, 4), (2, 5), (2, 6), (4, 2), (4, 3), (4, 4), (4, 5), (4, 6), (6, 1), (6, 2), (6, 3),$

$(6, 4), (6, 5), (6, 6)\}$

7. Refer to question 6 above, state true or false (give reason for your answer):

(i) A and B are mutually exclusive.

(ii) A and B are mutually exclusive and exhaustive.

(iii) $A = B'$

(iv) A and C are mutually exclusive.

(v) A and B' are mutually exclusive.

(vi) A', B' and C are mutually exclusive .

Ans. A: getting an even number on the first die

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

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

B: getting an odd number on the first die

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

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

C: getting the sum of the number on the dice

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

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

(i) $A \cap B = \emptyset$ therefore, A and B are mutually exclusive events. \therefore True

(ii) $A \cap B = \emptyset$ and $A \cup B = S$

Therefore, A and B are mutually exclusive and exhaustive events. \therefore True

(iii) $B' = \{(2, 1), (2, 2), (2, 3), (2, 4), (2, 5), (2, 6),$

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

$(6, 1), (6, 2), (6, 3), (6, 4), (6, 5), (6, 6)\} = A \therefore$ True

(iv) $A \cap C = \{(2, 1), (2, 2), (2, 3), (4, 1)\} \neq \emptyset$

Therefore, A and C are not mutually exclusive events. \therefore False

(v) $A \cap B' = A \neq \emptyset$ Therefore, A and B' are not mutually exclusive events. \therefore False

(vi) Since $A' = B$ and $B' = A$, $A \cap B = \emptyset$,

$A' \cap C = B \cap C = \{(1, 1), (1, 2), (1, 3), (1, 4), (3, 1), (3, 2)\} \neq \emptyset$

$B' \cap C = A \cap C = \{(2, 1), (2, 2), (2, 3), (4, 1)\} \neq \emptyset$

Therefore, A', B' and C are not mutually exclusive. \therefore False