PROBABILITY

CLASS 11
MODULE 3

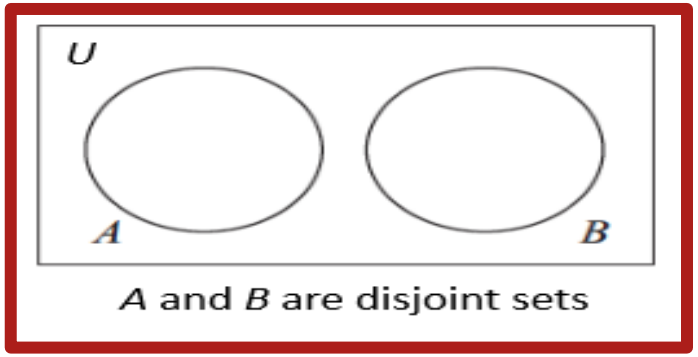
RECAP

- **Event:** Any subset E of a sample space S is called an event.
- **Impossible and Sure Events**
- **Simple Event**
- **Compound Event**
- **Complementary Event**
- **The Event 'A or B':** $A \cup B$
- **The Event 'A and B':** $A \cap B$
- **The Event 'A but not B':** $A - B$

RECAP

Mutually Exclusive Events: Two events A and B are called mutually exclusive events if the occurrence of any one of them excludes the occurrence of the other event, i.e., if they can not occur simultaneously. In this case the sets A and B are disjoint.

- For e.g. In the experiment of rolling a die
- S = {1, 2, 3, 4, 5, 6}
- A 'an odd number appears' and B 'an even number appears'
- A = {1, 3, 5} and B = {2, 4, 6}
- Clearly $A \cap B = \varphi$, i.e., A and B are disjoint sets.
- A and B are called mutually exclusive events.



A and B are disjoint sets

RECAP

Exhaustive Events: If $E_1, E_2, ..., E_n$ are n events of a sample space S and if

$$E_1 \cup E_2 \cup ..... \cup E_n = S$$

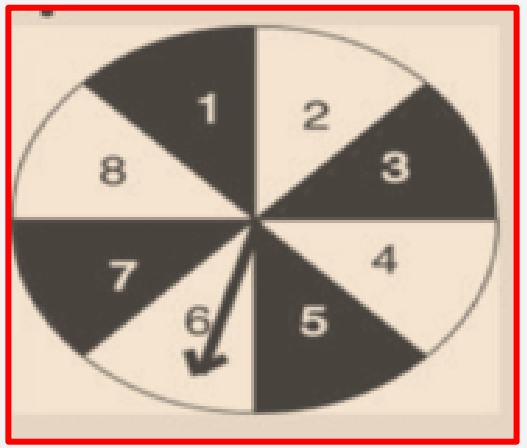
Then $E_1, E_2, ..., E_n$ are called exhaustive events.

- For e.g. if S = {1, 2, 3, 4, 5, 6}
- Let A: 'a number less than 4 appears'
  B: 'a number greater than 2 but less than 5 appears'
  C: 'a number greater than 4 appears'
- A = {1, 2, 3}, B = {3,4} and C = {5, 6}
- A ∪ B ∪ C = {1, 2, 3} ∪ {3, 4} ∪ {5, 6} = S.
- Such events A, B and C are called exhaustive events.

Events that cannot happen at the same time are mutually exclusive events. There is "no overlap"

RECAP

1) Let A be an event of getting the number 4 and B be the event of getting the number 6 in a single spin
2) Let P be an event of getting an even number and Q be an event of getting a multiple of 3 in a single spin



They can't both happen at once, you can't end up with a 4 and a 6 in one spin – Mutually Exclusive

They can both happen at once, if you spin a 6 it is a multple of 3 (3*2) and even – NOT Mutually Exclusive

You try☺ Are the events mutually exclusive?

3) Spinning an even number or a prime number on a single spin.

RECAP

Roll a dice!
Events that outcome is even number?

{2,4,6}

Events that outcome is odd number?

{1,3,5}

Their union makes the whole sample space!

What type of event??

TO POLL

Spinning an even number or a number less than 2 on a single spin

A) Not Mutually exclusive events
B) Exhaustive Events
C) Mutually exclusive and Exhaustive Events
D) Mutually exclusive events but not exhaustive events

Ex16.2, 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?

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

$E = \{4\}$

$F = \{2, 4, 6\}$

$E \cap F = \{4\} \cap \{2, 4, 6\}$

$= \{4\}$

$E \cap F \neq \phi$

Hence E and F are **not** mutually exclusive events

Question 2:

Exercise – 16.2

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

Solution

When a die is thrown, the sample space is given by S = {1, 2, 3, 4, 5, 6}.

Accordingly:

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

(ii) B = Ø

(iii) C = {3, 6}

(iv) D = {1, 2, 3}

(v) E = {6}

(vi) F = {3, 4, 5, 6}

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

$B \cup C = \{3, 6\}$, $E \cap F = \{6\}$

$D \cap E = \phi$, $A - C = \{1, 2, 4, 5\}$

$D - E = \{1, 2, 3\}$, $F' = \{1, 2\}$, $E \cap F' = \varnothing$

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

Solution

When three coins are tossed, the sample space is given by

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

Accordingly,

A = {HHH}

B = {HHT, HTH, THH}

C = {TTT}

D = {HHH, HHT, HTH, HTT}

We now observe that

$A \cap B = \phi, A \cap C = \phi, A \cap D = \{HHH\} \neq \phi$

$B \cap C = \phi, B \cap D = \{HHT, HTH\} \neq \phi$

$C \cap D = \phi$

(i) Event A and B; event A and C; event B and C; and event C and D are all mutually exclusive.

(ii)

(iii)

TRY

Ex 16.2, 5

Three coins are tossed. Describe

(i) Two events which are mutually exclusive.

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

$A = \{HHH\}$ $B = \{TTT\}$

$A \cap B = \phi$

Hence A & B are mutually exclusive

(ii)Three events which are mutually exclusive and exhaustive

$A = \{HTT, THT, TTH\}$ → **exactly two tail comes**

$B = \{HHT, HTH, THH, HHH\}$ → **at least two head**

$C = \{TTT\}$ → **only tail**

$A \cap B = B \cap C = A \cap C = \phi$

Since A & B, A & C, B & C are mutually exclusive

Hence A, B and C are mutually exclusive

$A \cup B \cup C = S$

Hence A, B & C are exhaustive events

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

A = {HHT, HTH, THH, HHH} ➡ at least two head

B = {HHH} ➡ only head

$A \cap B = \{HHH\}$

$\neq \phi$ A & B are not mutually exclusive

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

A = {HHH} B = {TTT} $A \cap B = \{HHH\} \cap \{TTT\} = \phi$

A & B are mutually exclusive

$A \cup B = \{HHH\} \cup \{TTT\} \neq S$

A & B are not exhaustive events

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

TRY

Home work
Ex 16.2 Q no. 6 &7