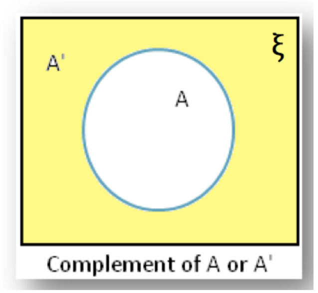
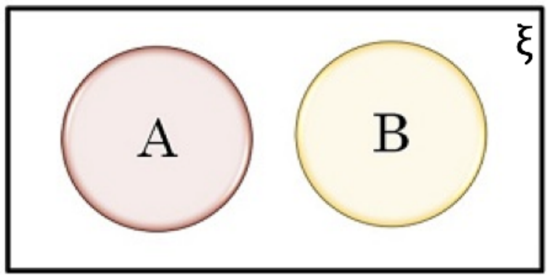
Probabilities: In the **examples**: ξ ={1, 2, 3, 4, 5, 6, 7} , C= {1, 2, 3, 4} and D= {3, 4, 5}

Symbol	Name: Meaning	Example
P(event)= $\frac{n(E)}{n(\xi)}$	Probabilities for an event to occur.	P (red cards in a set) = $\frac{n(E)}{n(\xi)} = \frac{26}{52} = \frac{1}{2}$
A∪B	Union: in A **or** B (or both)	C ∪D= {1, 2, 3, 4, 5}
A∩B	Intersection: in both A **and** B	C ∩D= {3, 4}
A'	Complement elements: not in A	D'= {1, 2, 6, 7}
Mutually exclusive events	Two events don't occur simultaneously.	P(A ∩B) = 0
Independent events	The occurrence of one event cannot control the occurrence of other.	P (A ∩ B) = P(A) × P(B)



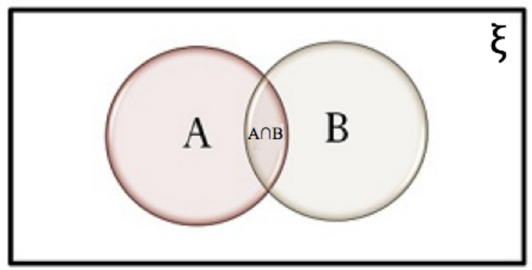
A and A' are complementary
P(A)= 1–P(A')

Mutually Exclusive Event



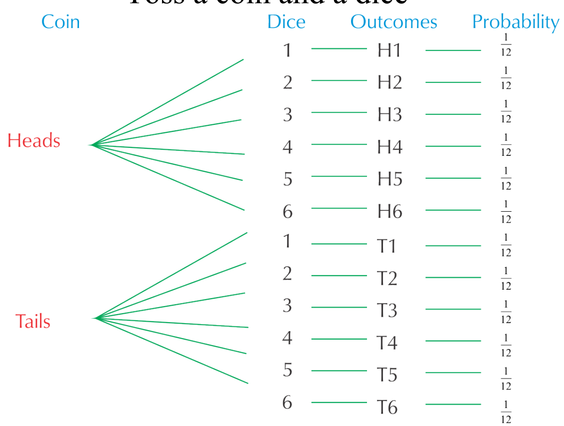
A and B are Mutually exclusive events, not overlap
P(A∪B)= P(A)+P(B), P(A ∩B) = 0

Independent Event

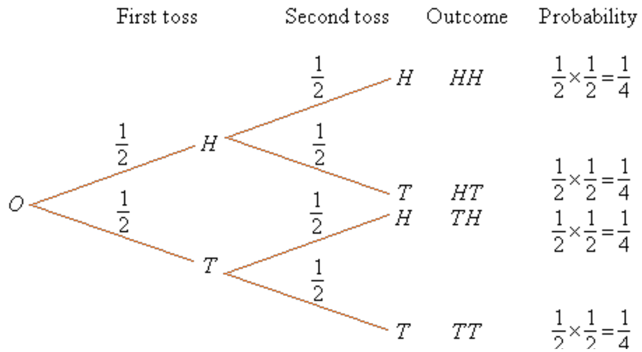


A and B are Independent events, overlap
P(A∪B)= P(A)+P(B) – P(A ∩ B), P (A ∩ B) = P(A) × P(B)

Toss a coin and a dice



Toss two coins



Two-way table of a coin and a dice

Possibilities for coin

DICE

Possibilities for dice

COIN	1	2	3	4	5	6
H	H1	H2	H3	H4	H5	H6
T	T1	T2	T3	T4	T5	T6

Summary —Probability

Review of probability

- Probabilities can be expressed as percentages, fractions or decimals in the range 0 to 1 (inclusive).
- Experimental probability $= \dfrac{\text{number of times an event has occurred}}{\text{total number of trials}}$.
- The theoretical probability that an event, *E*, will occur is $\mathrm{P}(E) = \dfrac{n(E)}{n(\zeta)}$
  where $n(E)$ = number of times or ways an event, *E*, can occur
  and $n(\zeta)$ = the total number of ways all outcomes can occur.
- $\mathrm{P}(\zeta) = 1$
- Venn diagrams provide a diagrammatic representation of sample spaces.

Complementary and mutually exclusive events

- Complementary events have no common elements and together make up the universal set.
- If *A* and *A′* are complementary events, then $\mathrm{P}(A) + \mathrm{P}(A') = 1$. This may be rearranged to:
  - $\mathrm{P}(A') = 1 - \mathrm{P}(A)$ or $\mathrm{P}(A) = 1 - \mathrm{P}(A')$.
- Mutually exclusive events have no common elements and cannot occur simultaneously.
- If events *A* and *B* are not mutually exclusive, then:
  - $\mathrm{P}(A \text{ or } B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \text{ and } B)$
    or
  - $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$, where $\mathrm{P}(A \cap B)$ is the probability of the intersection of sets *A* and *B*, or the common elements in sets *A* and *B*. This is the Addition Law of Probability.
- If events *A* and *B* are mutually exclusive, then:
  - $\mathrm{P}(A \text{ or } B) = \mathrm{P}(A) + \mathrm{P}(B)$
    or
  - $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B)$, since $\mathrm{P}(A \cap B) = 0$.
- Mutually exclusive events may or may not be complementary events.
- Complementary events are always mutually exclusive.

Tree diagrams

- Tree diagrams are useful in working out the sample space and calculating probabilities of various events, especially if there is more than one event. On each branch of a tree diagram, the probability associated with the branch is listed. The products of the probabilities given on the branches are taken to calculate the probability for an outcome.
- The probabilities of all outcomes add to 1.

Independent and dependent events

- Events are independent if the occurrence of one event does not affect the occurrence of the other.
- If events *A* and *B* are independent, then $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B)$. This is the Multiplication Law of Probability. Conversely, if $\mathrm{P}(A) \times \mathrm{P}(B) = \mathrm{P}(A \cap B)$, then events *A* and *B* are independent.
- Dependent events affect the probability of occurrence of one another.

Conditional probability

- Conditional probability is when the probability of an event is conditional (depends) on another event occurring first.
- For two events, *A* and *B*, the conditional probability of event *B*, *given* that event *A* occurs, is denoted by P(*B*|*A*) and can be calculated using the formula:

  $$\mathrm{P}(B \mid A) = \frac{\mathrm{P}(A \cap B)}{\mathrm{P}(A)}, \mathrm{P}(A) \neq 0$$

- The Multiplication Law for Probability gives $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B \mid A)$.