


PROBABILITY

- ▶ Probability :

It is the ratio of desired outcomes to total outcomes: $(\text{desired outcomes})/(\text{total outcomes})$.

- Probability of all outcomes always sums to 1.

Example:

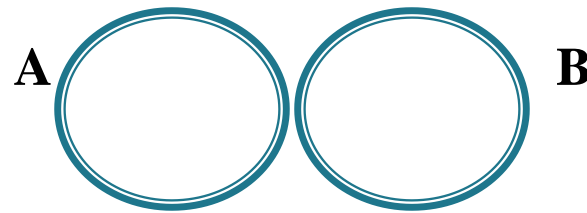
- ▶ On rolling a dice, you get 6 possible outcomes
 - ▶ Each possibility only has one outcome, so each has a probability of $1/6$
 - ▶ For example the probability of getting a number '2' on the dice is $1/6$
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▶ **MUTUAL EXCLUSIVE AND MUTUAL INCLUSIVE EVENTS**

▶ **Mutual Exclusive Event :**

These are the events which cannot occur both at the same time. For example, a set of outcomes of a single coin toss, which can result in either heads or tails, but not both.

- ▶ The Additive theorem of probability states if A and B are two mutual exclusive events then the probability of either A or B is given by

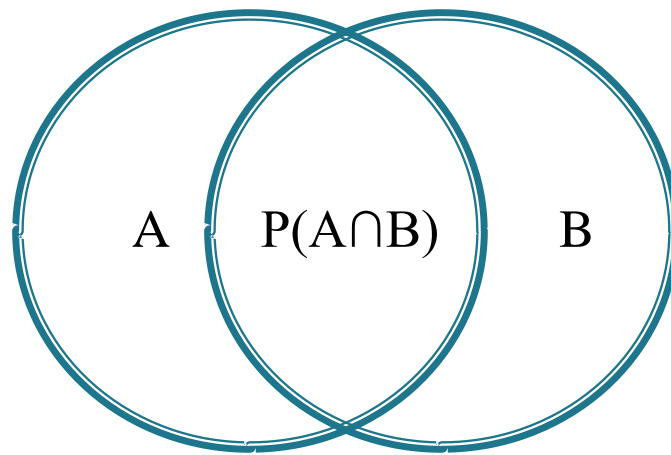


$$\mathbf{P(A \text{ or } B) = P(A) + P(B)}$$

- ▶ Mutual Inclusive Event :

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- ▶ The additive theorem of probability states if A and B are two inclusive events then the probability of either A or B is given by



$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

INDEPENDENT AND DEPENDENT EVENTS

- ▶ Independent Events :

Two events are independent if the outcome of first event doesn't affects the outcome of the second event. When two events, A and B are independent, then the probability of both occurring is :

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

- ▶ Dependent events :

Two events are dependent if the outcome of first event affect the outcome of the second event. When two events, A and B are dependent, then the probability of both occurring is :


$$P(A \text{ and } B) = P(A) \cdot P(B/A)$$


CONDITIONAL PROBABILITY

- ▶ Probability of an event or outcome based on the occurrence of a previous event or out come
- ▶ Conditional Probability of an event B is the probability that the event will occur given that event A has already occurred
- ▶ If A and B are dependent events then the expression for conditional probability is given by :

$$P(B/A) = P(A \text{ and } B) / P(A) \text{ or } P(A/B) = P(A \text{ and } B)/P(B)$$

- ▶ If A and B are independent events then the expression for conditional probability is given by :

$$P(B/A) = P(B)$$


► BAYE'S THEOREM :

It shows the relation between one conditional probability and its inverse. It is given as

$$P(B/A) = P(A/B).P(A)/P(B)$$

Example:

$P(A)$ is the probability that the stock price is increases by 5%, $P(B)$ is the probability that the CEO is replaced by 20%, $P(A/B)$ is the probability of the stock price increases by 5% given that the CEO has been replaced. Find $P(B/A)$ is the probability of the CEO replacement given the stock price has increased.

Sol:

$$P(B/A) = P(A/B).P(A)/P(B)$$

$$P(B/A) = (0.05)*(0.05)/(0.2)$$

► Examples:

1. What is the probability of spinning a prime number or an odd number on a spinner numbered 1 to 8?

Sol: $S = (1, 2, 3, 4, 5, 6, 7, 8)$

prime numbers = 1, 3, 5, 7 = $4/8 = 0.5$

2. For numbers 1 to 9, get the probability of getting a number less than 4 or 2?

Sol: set $S = (1, 2, 3, 4, 5, 6, 7, 8, 9)$

we want probability of number less than 4 or 2

less than 4 means we get $S = 1, 2, 3 = 3/9 = 0.33$

less than 2 means we get $S = 1 = 1/9 = 0.11$

3. Let X and Y are two independent events such that $P(X) = 0.3$ and $P(Y) = 0.7$. Find $P(X \text{ and } Y)$, $P(X \text{ or } Y)$.

Sol: We know that : $P(X \text{ and } Y) = P(X) * P(Y)$

$$= (0.3) * (0.7)$$

$$= 0.21$$

$$P(X \text{ or } Y) = P(X) + P(Y)$$

$$= 0.3 + 0.7$$

$$= 1$$