o Mutually Exclusive Events

Two events are mutually exclusive when two events cannot happen at the same time. The probability that one of the mutually exclusive events occur is the sum of their individual probabilities.

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

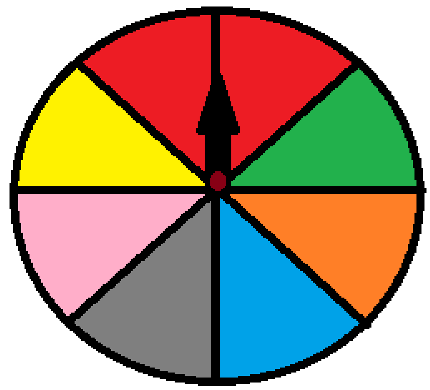
<u>Question</u> **:** There are two mutually exclusive events is a wheel of fortune. Let's say you win a bar of chocolate if you end up in a red or a pink field. What is the probability that the wheel stops at red or pink?

$$P(\text{red or pink})=P(\text{red})+P(\text{pink})$$

$$P(red) = \frac{2}{8} = \frac{1}{4}$$

$$P(pink) = \frac{1}{8}$$

$$P(red\ or\ pink) = \frac{1}{8} + \frac{2}{8} = \frac{3}{8}$$



o Ways of Showing Probability

It is often shown as a **decimal** or **fraction**.

<u>Example</u>: the probability of getting a "Head" when tossing a coin:

- As a fraction: ½
- As a decimal: **0.5**
- As a percentage: **50%**
- Or sometimes like this: **1-in-2**

o Postulates

1. For each Event A :

$$0 \le P(A) \le 1$$

2. $\bar{A}$ is a complement event for event A :

$$P(\bar{A}) = 1 - P(A) \Rightarrow P(A) + P(\bar{A}) = 1$$

<u>Example</u>: Suppose you have a sample space S = 800, event A = 80. Find $\bar{A}$, P(A) and $P(\bar{A})$.

$\bar{A}$ = S-A = 800 - 80 = 720
P(A) = 80/800 = 10%
$P(\bar{A})$ = 1 - P(A) = 90% or 720/800 = 90%

3. A and B are two events, $A \subseteq B$:

$$P(A) \leq P(B)$$

4. A and B are two independent events :

$$P(A|B) = P(A)$$
$$P(B|A) = P(B)$$
$$P(A,B) = P(A) * P(B)$$

5. A and B are two independent events, the probabilities of occurrence A or B is:

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

Example: In a race involving three horses A,B and C, the probability that A win is twice as likely as B and the probability that B win is twice as likely as C. What the probability that A or C win.

$P(C) = p$ probability of C winning
$P(B) = 2*P(C) = 2p$ probability of B winning
$P(A) = 2*P(B) = 4p$ probability of A winning
$P(A) + P(B) + P(C) = 1$
$4p+2p+p = 1$
$7p = 1$
$P = 1/7$
$P(C) = 1/7$ $P(B) = 2/7$ $P(A) = 4/7$
$P(A \cup C) = P(A) + P(C)$
$= 4/7 + 1/7$
$= 5/7$

6. Conditional Probability : A and B are two dependent events, the probability of B occurrence after A occurrence is:

$P(B|A) = P(A, B) / P(A)$ $P(A) > 0$
Probability of A after B occurrence is:
$P(A|B) = P(A, B) / P(B)$ $P(B) > 0$

7. Joint Probability: A & B are two dependent events, the probability of A occurrence **OR** B occurrence is:

$$P(A \text{ or } B) = P(A \cup B) = P(A) + P(B) - P(A,B)$$

Where,

$$P(A,B) = P(A \cap B)$$

***Example*:** Two dice are rolled once. Calculate the probability that the sum of the numbers on the two dice is **6**.

Possible outcomes (Sample Space) = {(1, 1), (1, 2),.........,(1, 6), (2, 1), (2, 2),........,(2, 6), (3, 1), (3, 2),.........,(3, 6), ...,(4, 1), (4, 2),..........,(4, 6), (5, 1), (5,2),........, (5, 6), (6, 1), (6, 2),.........,(6, 6)}

Favorable outcomes to get **6** of two dice are: (1, 5), (2, 4), (3, 3), (4, 2) and (5, 1)

Total possible outcomes = **36**

Number of favorable outcomes = **5**

Use, probability formula = No. of favorable outcomes / Total No. of possible outcomes

P(sum of two event is 6) = 5/36 = 0.1389

***Example*:**: *What is the likelihood of choosing a day that falls on the weekend when randomly picking a day of the week?*

The number of events is two (since two days out of the week are weekends), and the number of outcomes is seven. The probability is 2 ÷ 7 = 2/7 or .285 or 28.5%.

***Example*:** *A jar contains 4 blue marbles, 5 red marbles and 11 white marbles. If a marble is drawn from the jar at random, what is the probability that this marble is red?*

The number of events is five (since there are five total marbles), and the number of outcomes is 20. The probability is 5 ÷ 20 = 1/4 or .25 or 25%