**Probability**

Probability is a measure of the chance of an event happening, it ranges from 0 (impossible) to 1 (certain)

It is calculated by dividing favorable outcomes by possible outcomes

Eg: Cricket Win predictor, weather predictions

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Probability of head/tail = ½ = 0.5

If you flip a coin large number of times (like 10K times), then the probability of getting a head/tail is 50%

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When you are conducting an experiment large number of times that’s when the **probability distribution** happens.

Probability distribution holds true when number of trials are large number.

Probability is in between 0 to 1.

P(queen of heart and queen of diamond) = 0

Since we can’t pick two at a time

P(any queen or any king) = 8/52

Queens are 4, kings are 4

**Complimentary Events:**

P(3) = 1/6

P(not 3) = 1 – 1/6 = 0.83

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| **Addition Rule** | **Multiplication Rule** |
| To find the probability of **either** of two events happening. | To find the probability of **both** events happening. |
| Two events are **Mutually Exclusive, if they** cannot happen at the same time:  P(A or B) = P(A) + P(B) | Two events are **Independent if they** do not affect each other.  P(A and B) = P(A) × P(B) |
| **Ex:** You roll a fair 6-sided die. What is the probability of getting a **3** or a **5**?  P(3 or 5) = 1/6 + 1/6 | **Ex:** You flip a coin and roll a die. What is the probability of getting **heads** on the coin and a **3** on the die?  P(Heads and 3) = 1/2​ × 1/6​ |
| Two events are **Not Mutually Exclusive**, if they can happen at the same time.  P(A or B) = P(A) + P(B) −P(A and B) | Two events are **Dependent if they** affect each other.  P(A and B) = P(A) × P(B∣A)  Where P(B∣A) is the probability of B occurring **after** A has already occurred. |
| **Ex:** Finding the probability of drawing either a **heart** or a **king** from a deck of 52 cards.   * There are **13 hearts** in deck of cards * There are **4 kings** in a deck * One of these kings is also a heart, so we need to adjust for this overlap.   (1 king of hearts in 52)  P(Heart or King) =  P(Heart) + P(King) − P(Heart and King)  P(Heart or King) = 13/52 + 4/52 – 1/52 | **Ex:** You draw two cards from a deck without replacement. What is the probability of drawing a **heart** first, and then a **king**?   * There are **13 hearts** in deck of cards * There are **4 kings** in a deck * One of these kings is also a heart   P(Heart) = 13/52.  After drawing a heart, there are 51 cards left, and the probability of drawing a **king** (if one king hasn’t been drawn yet) is  P(King) = 4/51  P(Heart and King)= 13/52 \* 4/51 |

**Examples:**

**Q:** You have a bag with 10 red balls and 10 blue balls. Without replacing the balls, what is the probability of drawing a red ball first, followed by a blue ball?

**Sol’n:**

There are 10 red balls out of 20 total balls, so the probability of drawing a red ball first is:

P(Red first) = 10/20 = 1/2

After drawing a red ball, there are now 19 balls left in the bag, and the number of blue balls remains 10.

P(Blue second) = 10/19

Since the events are **dependent** (the first draw affects the second), we multiply the probabilities of each event occurring:

P(Red first, Blue second ) = P(Red first) × P(Blue second)

P(Red first, Blue second) = ½ \* 10/19 = 5/19