

Probability Distribution

1. Binomial Distribution:

- Imagine flipping a coin 10 times and counting the number of heads. The binomial distribution describes the probability of getting a specific number of successes (heads) in a fixed number of trials (10 flips) where each trial has only two outcomes (heads or tails).
- **Key characteristics:**
 - Fixed number of trials (n).
 - Two possible outcomes per trial: success (S) and failure (F).
 - Probability of success (p) remains constant throughout the trials.
 - Probability of failure (q) = $1 - p$.
- **Example:** Probability of getting exactly 5 heads in 10 coin flips.

2. Multinomial Distribution:

- Think of rolling a die 3 times. Unlike the binomial distribution with just two outcomes, the multinomial distribution applies to situations with more than two possible outcomes per trial. Here, each roll can result in any number (1 to 6) on the die.
- **Key characteristics:**
 - Fixed number of trials (n).
 - More than two possible outcomes (k) per trial (e.g., 1 to 6 on a die).
 - Probabilities of each outcome (p_1 to p_k) add up to 1.
- **Example:** Probability of getting one 3, one 4, and one 5 in three rolls of a die.

3. Geometric Distribution:

- Imagine repeatedly flipping a coin until you get heads for the first time. The geometric distribution describes the probability of needing a specific number of trials (flips) to achieve the first success (heads) in a series of independent trials where each trial has only two outcomes (heads or tails).
- **Key characteristics:**
 - Only interested in the number of trials (x) needed for the first success.
 - Two possible outcomes per trial: success (S) and failure (F).
 - Probability of success (p) remains constant throughout the trials.
 - Probability of failure (q) = $1 - p$.
- **Example:** Probability of needing 4 attempts to get your first heads in coin flips.

4. Poisson Distribution:

- Picture the number of customers arriving at a bank in a given hour. The Poisson distribution describes the probability of a certain number of events (customer arrivals) occurring in a fixed interval (one hour) when the events happen independently and at a constant average rate (average number of customers arriving per hour).
- **Key characteristics:**
 - Interested in the number of events (x) occurring in a fixed interval.
 - Events occur independently and at a constant average rate (λ) within the interval.
- **Example:** Probability of having 3 customers arrive at a bank in a 1-hour period, given an average arrival rate of 2 customers per hour.