

Counting

- In discrete mathematics, counting is an essential idea that is needed to solve combinatorial, statistical, and computer science problems. The following are the main ideas and methods:
 - ✓ **Permutations:** arrangements in which hierarchy counts. $n!$ is the number of permutations for n different items. The formula for choosing r objects from n is

$$P(n,r) = \frac{n!}{(n-r)!}$$
 - ✓ **Combinations:** choices in which the order is irrelevant. There are an infinite number of ways to select r objects from n

$$\binom{n}{r} = \frac{n!}{r!(n-r)!}$$
 - ✓ **Pigeonhole principle:** When m containers hold n items each and $n > m$, then at least one container contains more than one item. This idea aids in demonstrating the presence of specific set attributes.
 - ✓ **Inclusion:** used for counting the elements in the union of sets that overlap.
- These counting methods are fundamental to many disciplines, such as operations research for optimization issues, statistics for probability and modeling, and computer science for algorithms and data structures. Gaining knowledge of permutations, combinations, the inclusion-exclusion principle, and the pigeonhole principle lays a strong basis for solving increasingly challenging mathematical and real-world issues.