Product Rule: A procedure can be broken down into a sequence of two tasks. There are n1 ways to do the first task and n2 ways to do the second task. Then there are n1 × n2 ways to do a procedure.

Sum Rule: If a task can be done either in one of n1 ways or in one of n2, where none of the set of n1 ways is the same as any of the n2 ways, then there are n1+ n2 ways to do the task.

Subtraction Rule: If a task can be done either in one of n1 ways or in one of n2 ways, then the total number of ways to do the task is n1+ n2 minus the number of ways to do the task that are common to the two different ways. [ |A ∪ B|= |A| + |B| - |A ∩ B|

Division Rule: There are n/d ways to do a task if it can be done using a procedure that can be carried out in n ways, and for every way w, exactly d of the n ways corresponds to way w.

Division Rule in Terms of Sets: If the finite set A is the union of n pairwise disjoint subsets each with d elements, then n = |A|/d.

Division Rule in Terms of Functions: If f is a function from A to B, where both are finite sets, and for every value y ∈ B there are exactly d values x ∈ A such that f(x) = y, then |B| = |A|/d.

Tree Diagrams: We can solve many counting problems through the use of tree diagrams, where a branch represents a possible choice and the leaves represent possible outcomes.

Pigeonhole Principle: If k is a positive integer and k + 1 objects are placed into k boxes, then at least one box contains two or more objects.

Generalized Pigeonhole Principle: If N objects are placed into k boxes, then there is at least one box containing at least ⌈N/k⌉ objects.

Permutations: A permutation of a set of distinct objects is an ordered arrangement of these objects. An ordered arrangement of r elements of a set is called an r-permutation.

Combinations: An r-combination of elements of a set is an unordered selection of r elements from the set. Thus, an r-combination is simply a subset of the set with r elements.

Binomial coefficient: Binomial[n,k]

Double Counting Proof: A double counting proof uses counting arguments to prove that both sides of an identity count the same objects, but in different ways.

Bijective Proof: A bijective proof shows that there is a bijection between the sets of objects counted by the two sides of the identity.

Distinguishable: When objects are different from each other

Identical: When objects are identical to each other

Distinguishable boxes: Labeled boxes

Indistinguishable boxes: Unlabeled boxes