The Addition Principle (The Rule of Sum)

- If A and B are disjoint events with n_1 and n_2 possible outcomes, respectively, then the total number of possible outcomes for event (A **or** B) is $n_1 + n_2$.

- If a first task can be performed in m ways, while a second task can be performed in n ways, and the two tasks cannot be performed simultaneously, then performing either task can be accomplished in any one of $m + n$ ways.

- If there are r_1 different objects in the first set, r_2 objects in the second set, …, and r_m objects in the m^{th} set, and *if the different sets are disjoint*, then the number of ways to select an object from one of the m sets is $r_1 + r_2 + \ldots + r_m$.

- Let S and T be finite sets. If S and T are disjoint, i.e., if $S \cap T = \emptyset$, then $|S \cup T| = |S| + |T|$.

[*Note*: this rule establishes a relationship between logical or, disjoint set union, and arithmetic addition.]

The Multiplication Principle (The Rule of Product)

- If there are n_1 possible outcomes for a first event and n_2 possible outcomes for a second event, there are $n_1 \cdot n_2$ possible outcomes for the sequence of the two events.

- If a procedure can be broken down into first and second stages, and if there are *m* possible outcomes for the first stage and if, for each of these outcomes, there are *n* possible outcomes for the second stage, then the total procedure can be carried out, in the designated order, in *mn* ways.

- Suppose a procedure can be *broken into m successive (ordered) stages*, with r_1 outcomes in the first stage, r_2 outcomes in the second stage, …, and r_m outcomes in the mth stage. If the number of outcomes at each stage is independent of the choices in previous stages and if the composite outcomes are all distinct, then the total procedure has $r_1 \times r_2 \times \ldots \times r_m$ different composite outcomes.

- For finite sets $S_1, S_2, \ldots, S_k$, selecting one element from each set is equivalent to forming an element from the cartesian product of all the sets (a *k*-tuple).

$$\left|S_1 \times S_2 \times \cdots \times S_k\right| = \prod_{j=1}^{k} S_j$$

[*Note*: this rule establishes a relationship between logical and, set cartesian product, and arithmetic multiplication.]