

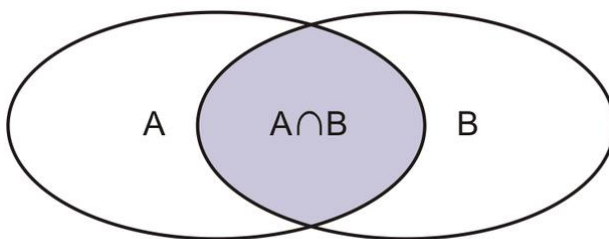
Probability: Addition, Multiplication, and Conditional

Addition Rule:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

The probability of event A or event B can be found by adding the probability of the separate events A and B and subtracting any intersection of the two events.

More intuitively, if we were to take the area of the Venn Diagram below, we would add the areas of figures A and B, and subtract out one overlap's worth of area, which represents the intersection of A and B.



Multiplication Rule:

$$P(A \text{ and } B) = P(A) * P(B|A)$$

The probability of events A and B occurring can be found by taking the probability of event A occurring and multiplying it by the probability of event B happening *given* that event A already happened.

If events A and B are independent, simply multiply $P(A)$ by $P(B)$.

Treating Dependent Events as Independent:

In certain cases, where the sample size is less than 5% of the total population, one may treat events as independent even if they are truly dependent, because it would be rare to select the same item twice. This is known as the *5% Rule for Cumbersome Calculations*.

Conditional Probability:

$$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$$

The probability of event B occurring, given that event A has occurred is equal to the probability of event A and B occurring divided by the probability of event A occurring.