Probability

- Definitions
- Addition Rule
- Multiplication Rule

Definition of Probability

- Event: Any collection of outcomes of a procedure.
- Simple Event: An outcome that is not a collection of simpler components.
- Sample Space: All possible simple events.

$$P(A) = \frac{\text{Number of Simple Events in } A}{\text{Number of Simple Events in the Sample Space}}$$

Law of Large Numbers

- Law of Large Numbers: If an experiment involves many many trials, then the proportion of successes will be very close to the theoretical proportion.
  For example, if you toss a fair coin a billion times, it is highly likely that the proportion of heads will be very close to 0.5.

The Addition Rule

- P(A OR B) is the probability that either A occurs, B occurs, or both.

$$P(A \text{ OR } B) = P(A) + P(B) - P(A \text{ And } B)$$

Rule of Complements

- $\overline{A}$ is called the complement of A or the outcome of A not occurring.

$$P(\overline{A}) = 1 - P(A)$$

Multiplication Rule

- If an experiment is run twice with replacement then:

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

Conditional Probability

- The probability of an event A occurring given the knowledge that B has already occurred is denoted by the conditional probability statement:

$$P(A \mid B)$$

Multiplication Rule

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

If A and B are independent events then

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

Independence Guideline

- If the sample size is no more than 5% of the population size, treat the solutions as independent events *(even though they are slightly dependent).*