Sample Problems

- 1. Suppose a car number plate contains 3 distinct letters followed by 3 digits with the first digit not zero. How many car number plates can be made?
- 2. Determine the number of outcomes if a coin is tossed 3 times.
- 3. In how many ways can 8 people be seated in a row of 5 chairs?

- 4. How many distinct arrangements can be made by using all the letters in the word STATISTICS?
- 5. In how many ways can 4 persons be arranged in a circular table?
- 6. In a deck of 52 cards, how many ways can we select 5 diamonds?

Probability

- **Probability**
  - may be regarded as a theory that is concerned with the possible outcomes of experiments
  - chance
  - possibility
  - value of prob is, $0 \leq P(E) \leq 1$
- **Sample space**
  - is the set of all possible outcomes in a statistical experiment and it is denoted by S
  - Tossing a coin once: S = {H, T}

- **Statistical Point** – each outcome in a statistical experiment
- **Event** – is any subset of a sample space and it is denoted by **E**

Example:

Consider tossing a coin twice and let **E** be the event that at least one head occurs.

E = {HT, TH, HH}

- **Classical Probability**

  - is based on the assumption that the outcomes of an experiment are equally likely.

  Example:

  Probability of winning a raffle ticket from 1000 distinct raffle ticket numbers

  $$P = 1/1000$$

  $$\text{Prob of an event} = \frac{\text{\# of favorable outcomes}}{\text{total \# of possible outcomes}}$$

- **Empirical/ Relative Frequency Approach**

  It defines probability as either:

1. The observed relative frequency of an event in a very large number of trials, or
2. The proportional of times that an event occurs in the long run when conditions are stable.

$$\text{Prob of event happening} = \frac{\text{\# of times event occurred in past}}{\text{total \# or observations}}$$

- **Subjective probability**

  - is the likelihood of a particular event happening that is assigned by an individual based on whatever evidence is available.

Examples:

1. My head aches, I think we're in for a heavy downpour.
2. The probability that you will pass IT3102N is 80%.

- **Mutually Exclusive Events**

  - are events that cannot happen or occur simultaneously

  Example:

  A card is drawn from a deck of 52 cards. What is the probability that the card drawn is a king or an ace?

  $$P = 4/52 + 4/52 = 8/52 = 2/13$$

  $$\mathbf{P(A \cup B) = P(A) + P(B)}$$

- **Non-Mutually Exclusive Events**

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

Examples:

1. A card is drawn from a deck of 52 cards. What is the probability that the card drawn is an ace or a heart?

2. A pair of dice is rolled once. What is the probability that a doublet or an 8 appears?

- **Independent Events**

  - the probability of getting event A is in no way affects the probability of getting event B.

$$P(A \cap B) = P(A) \bullet P(B)$$

Example:

Consider drawing 2 numbers with replacement from a population of 7 scores. What is the probability of getting a number 3 in the first draw and a number 5 in the second draw?

- **Dependent Events**

  - the probability of getting event A will affect or influence the probability of getting event B.

$$P(A \cap B) = P(A) \bullet P(B/A)$$

$$= P(B) \bullet P(A/B)$$

Example:

Consider drawing 2 numbers without replacement from a population of 7 scores. What is the probability of getting a number 3 in the first draw and a number 5 in the second draw?

- **Conditional Probability**

$$P(A/B) = \frac{P(A \cap B)}{P(B)}, \quad P(B) \neq 0 \quad \text{or} \quad P(B/A) = \frac{P(A \cap B)}{P(A)}, \quad P(A) \neq 0$$

Example:

The probability that a student fails Statistics is 0.63, the probability that he fails Physics is 0.80, and the probability that he fails both subjects is 0.25.

1. If he failed Statistics, what is the probability that he failed Physics?

2. Given that he failed Physics, what is the probability that he will fail Statistics?

Binomial Probability

Example:

A coin is tossed 8 times in succession. What is the probability

1. of obtaining exactly 6 heads?
2. of obtaining at least 6 heads?

- **Normal distribution**

  - is the most important continuous probability distribution in the entire field of statistics. Its graph, called the normal curve, is the bell-shaped curved that describes so many sets of data that occur in nature, industry and research.