CHAPTER 6

PROBABILITY

PROBABILITY

- Probability is the number of ways a particular outcome can occur divided by the number of possible outcomes.
- It is a measure of how often we expect an event to occur *in the long run*.
- Probabilities range from 0 (can never happen) to 1 (must happen)

PROBABILITY

- It is often convenient to discuss probabilities in terms of **ODDS**.
- To convert odds to a probability
  - Add the two numbers that are given
  - Use the first number as the numerator and the sum as the denominator
- **LAWS OF CHANCE**
  - With large number of trials, we can be very accurate about the number of times a particular outcome will occur, but I cannot know which trials will yield a particular outcome. In other words, I can make good "long run" predictions and poor "short term" predictions.
- **DEGREES OF BELIEF:** Probability is sometimes used to express the strength of a belief about the likelihood of an outcome.

FACTORS AFFECTING JUDGMENTS ABOUT PROBABILITY

- The research indicates that the most people are biased in their assessment of probabilities. That is to say, people fail to appreciate *the nature of randomness*
  - **The search for meaning**: people seek causes for events that happen to us and other, therefore most of us rarely consider the randomness of many events.
  - **Overconfidence:** it is indicated that people tend to be more confident in their decisions about probabilistic events than they should be.
    - People tend to be most confident in uncertain situations when they believe that they have control over the uncertain events.
    - Illusion of Control
    - Sayısal Loto

COMPUTING PROBABILITIES IN MULTIPLE-OUTCOME SITUATIONS

- **AND Rule**: when we want to find the probability of one event **and** another event, we multiply their separate probabilities.
  - The probability of both events occurring should be **less likely** than either event alone and it is.
- **OR Rule**: when we want to find the probability of one event **or** another event, we add their separate probabilities.
  - The probability of both events occurring should be **higher than** either event alone and it is.

COMPUTING PROBABILITIES IN MULTIPLE-OUTCOME SITUATIONS

- We can use the "or rule" and "and rule" when we're interested in are independent.
  - Two events are independent when the occurrence of one of them does not influence the occurrence of the other.
- Or Rule requires that the outcome be mutually exclusive, which means that if one occurs, the other cannot occur.

COMPUTING PROBABILITIES IN MULTIPLE-OUTCOME SITUATIONS

- **Conjunction Error-Applying the "And Rule"**
- Tversky and Kahneman's Experiment indicated that most of participants made the error of believing that the occurrence of two events is more likely that the occurrence of one of them.
- **Cumulative Risks-Applying the "Or Rule"**
- When we repeatedly expose to a risky situation, over time the probability of the risk increases.

SUBJECTIVE PROBABILITY

- Subjective Probability refers to personal estimates of the likelihood of events.
- Gambler's Fallacy: It is a misconception in which people believe that chance processes should be self-correcting so that if an event has not occurred in a while it is now more likely to occur.
- Base-Rate Neglect: Most people ignore the low base rate and estimate their answer as closer to the higher secondary rate.

MAKING PROBABILISTIC DECISIONS

- Nonregressive Judgments
- Regression toward the mean: when someone scores extremely high on some scale, she or he will score closer to the average the second time.

STATISTICAL USE AND ABUSE

- On the Average: Averages can be misleading when the samples are not representative of the population
- Precision: People are generally impressed with precise statistics
- Significant Differences
- Extrapolation: It occurs when a value is estimated by extending some known values.

INTRODUCTION TO PROBABILITY

- Inferential statistics and the concept of probability are closely connected to each other.
- The relationship between samples and populations are defined in terms of probability. In other words, by knowing the population, we can determine the probability of obtaining specific samples.
- In order to reach the goal of inferential statistics, a two-stage process is used.
  - In the first stage, we use probability for identifying the types of samples that probably would be obtained from a specific population.
  - In the second stage, we reverse the probability rules to allow us to move from samples to population.

INTRODUCTION TO PROBABILITY

- Random Sampling
  - A random sample has two requirements:
    1. It requires that each individual in the population has an equal chance of being selected. First one assures that there is no bias in the selection process.
    2. The probabilities must stay constant from one selection to next if more than one individual is selected. To keep the probabilities constant from one selection to the next, you should return each individual to the population before you make the next selection. This process is called *sampling with replacement*.

PROBABILITY AND NORMAL DISTRIBUTION

- The most common shape of population distributions is normal distribution.
- Normal distribution is symmetrical with highest frequency in the middle and frequencies tapering off as you move toward either extreme.
- A normal distribution can also be described by the proportions of area contained in each section of the distribution. The sections of a normal distribution is often identified in z-score units.

PROBABILITY AND NORMAL DISTRIBUTION

- Unit Normal Table
  - It lists proportions of the normal distribution for a full range of possible z-score values.
  - It contains four columns.
    - **Column A** lists **z-scores** corresponding to different positions in a normal distribution.
    - **Column B** presents the proportion in the **body**
    - **Column C** shows the proportion in the **tail**.
    - **Column D** identifies the proportion that located **between the mean and z-score.**

PROBABILITY AND NORMAL DISTRIBUTION

- ATTENTION
  - The body is always the larger part of the distribution whether it is on the right-hand side or left-hand side. Similarly, the tail is the smaller section whether it is on the right or the left.
  - Because the normal distribution is symmetrical, the proportions on the right-hand side are exactly the same as the corresponding proportions on the left-hand side. Note that the table does not contain negative z-score values. To find proportions for negative z-scores, you must look at the proportions for the positive value of z.
  - Proportions are always positive.

PROBABILITY AND BINOMIAL DISTRIBUTION

- When a variable is measured on a scale consisting of exactly two categories, the resulting data are called binomial. For instance: heads-tails, high or low depression and true-false.
- In binomial distributions, the researcher often knows the probabilities associated with each of the two categories. Therefore the question interest is the number of times each category occurs in a series of trials or in a sample of individuals.
  - What is the probability of obtaining 15 heads in 20 tosses of a balanced coin?

THE BINOMIAL DISTRIBUTION

- NOTATION
  - The two categories are identified as A and B.
  - The probabilities associated with each category are identified as
    - p=p(A)=the probability of A
    - q=p(B)=the probability of B
    - P+q=1.00
  - The number of individuals or observations in the sample is identified by n
  - The variable X refers to the number of times category A occurs in the sample.
    - X can have any value from 0 to n

THE BINOMIAL DISTRIBUTION

- Binomial distribution tends to approximate a normal distribution, particularly when n is large.
- Specifically, the binomial distribution will be a nearly perfect normal distribution when pn and qn are both equal to or greater than 10
- When calculating probabilities in binomial distribution, we should use real limits of X