A P S T A T I S T I C S

Chapter 6 PROBABILITY-*Randomness*

THE STUDY OF CHANCE BEHAVIOR

This chapter introduces you to the concept of chance behavior. Probability is the branch of mathematics that describes the pattern of chance outcomes. When we produce data by random sampling or randomized comparative experiments, probability helps us answer the question, "What would happen if we did this many times?" Probability calculations and an understanding of random behavior are the basis for inference.

Chapter Objectives

- ☐ Perform a simulation of a probability situation using a table of random numbers or technology.
- ☐ Use the basic rules of probability to solve problems.
- ☐ Write out the sample space of a random phenomenon and use it to answer probability questions.
- ☐ Describe the intersection and union of two events.
- ☐ Describe the concept of independence.
- ☐ Solve problems involving conditional probabilities using tree diagrams and/or Bayes' Rule when appropriate.

CHAPTER 6

☑ Simulations
- State the problem/random phenomenon
- State the assumptions
- Assign digits to represent outcomes
- Simulate many repetitions
- State your conclusion

☑ Probability Models
- Random Phenomenon
- Probability
- Sample Space
- Probability Model

☑ Probability Rules
- Addition Rule
- Multiplication Rule
- Conditional Probabilities
- Bayes' Rule

MON	TUE	WED	THU	FRI
3 6.1	**4 6.1**	**5 Quiz**	**6 No Class**	**7 6.2**
2 Hour Late Start • Simulation Activity	• Simulation Examples	• **Quiz 6.1**	• **Opportunities Day**	• Random Behavior • Probability Defined • Flipping Coins
6.1-6.4	**6.8-6.9, 6.12**			**6.22, 6.24, 6.28**
10 6.2	**11 6.3**	**12 6.3**	**13 Review**	**14 Exam**
• Probability Rules • Sample Space • Multiplication Counting Principle	• General Addition Rule • General Multiplication Rule	• Conditional P(x) • Tree Diagrams • Bayes' Rule	• Probability Practice	• **Chapter 6 Exam**
6.29, 32-33, 36, 38, 44	**6.71-78**	**6.82, 6.86-88**		

"The most important questions of life are, for the most part, really questions of probability."

~Pierre Simon de La Place

Chapter 6 Objectives and Skills:

These are the expectations for this chapter. You should be able to answer these questions and perform these tasks accurately and thoroughly. Although this is not an exhaustive review sheet, it gives a good idea of the "big picture" skills that you should have after completing this chapter. The more thoroughly and accurately you can complete these tasks, the better your preparation.

The Idea of Probability

Random phenomenon...individual outcomes are uncertain, but there is a regular distribution of outcomes in a large number of repetitions.

Probability...proportion of times an event occurs in many repeated events of a random phenomenon. Probability can also be thought of as long-term relative frequency.

Independent events (trails)...outcome of an event (trial) does not influence the outcome of any other event (trial).

Probability Models

- ☐ Sample space: The set of all possible outcomes of a random phenomenon
- ☐ Event: any outcome or a set of outcomes of a random phenomenon
- ☐ Probability model: a mathematical description of a random phenomenon consisting of two parts: a sample space "S" and a way of assigning probabilities to particular events.
- ☐ It is very important to find all possible outcomes in a sample space. To do this, you may want to use a tree diagram or the multiplication counting principle.
- ☐ If A is an event, then 0 ≤ P(A) ≤ 1
- ☐ Complement rule: P(not A) = 1 - P(A).
- ☐ Two events are disjoint, or mutually exclusive, if they have no outcomes in common. If A and B are disjoint, then P(A or B) = P(A) + P(B).
- ☐ Two events are independent if knowing that one occurs does not change the probability of the other. If events A and B are independent, then
  P(A and B) = P(A)P(B).

General Probability Rules

- ☐ There are basic laws that govern uses of probability. An understanding of these laws is important for those who wish to utilize statistics in practical and meaningful ways.
  - ☑ For any two events A and B,
  - ☑ P(A or B) = P(A) + P(B) - P(A and B).
  - ☑ If A and B are disjoint, then P(AandB)= 0.
  - ☑ Prob(B|A) = P(A and B)/P(A).
- ☐ The probability formulas are useful, but often times they are not needed if sample spaces are small and one uses common sense.
- ☐ In many problems, a tree diagram may help organize information and make calculating probabilities somewhat easier. One type of problem in which tree diagrams are especially useful is that of the "converse problem" as studied by Thomas Bayes. His findings, known as Bayes' Rule or Bayes' Theorem, allow us to solve problems such as "Given somebody tests positive for a disease, what is the probability they actually have that disease?"

☑ **Bayes' Rule**

$$P(A \mid B) = \frac{P(A)P(B \mid A)}{P(A)P(B \mid A) + P(A')P(B \mid A')}$$

Rather than memorizing the formula, I'd suggest using a tree diagram and a little common sense...but that's just me.