2.4 Tree Diagrams and Probability Models

Learning Objectives

• Understand how to build and properly notate a tree diagram • Understand how to calculate probabilities using a tree diagram • Understand how to verify if a tree diagram is correct • Be able to build a probability model by using a tree diagram

As we advance through probability, it becomes very apparent that we need to be quite organized with our problems as they become more complex. In this section we will use tree diagrams to help us calculate probabilities for given situations. **Tree diagrams** are a visual aid that can help us break down a situation and calculate probabilities. There are two key principles that we must observe for all tree diagrams. First of all, to find the total probability for any given branch on a tree, multiply the individual probabilities along that branch. Secondly, the sum of the probabilities from the ends of each branch must total to 1. We will examine several examples of probabilities using tree diagrams in order to solidify our understanding of this concept.

Example 1

At a restaurant, there are two breakfast platters that are served, one featuring pancakes and one featuring eggs. There are also two choices for drinks, milk or juice. Thirty percent of customers choose the pancake platter while 70 percent choose the egg platter. Forty percent of customers choose milk while 60 percent choose juice. Build a probability model for this situation by using a tree diagram!

Solution

Example 2

The Tigers and the Athletics baseball teams are playing a best-of-three playoff series. The first team to win two games is the winner of the series. Suppose the Tigers have a 60% chance to win any game they play against the Athletics. Build a tree diagram and then a probability model to determine the probability of each team winning the series.

Solution

Example 3

You are dealt two cards from a standard deck of 52 cards. What is the probability that the two cards can be classified as a red card and a face card (in either order)?

Solution

Example 4

A coin is flipped and then two dice are rolled. Build a probability model that shows how likely it is to get heads followed by doubles, heads and a non-doubles, tails and doubles, and tails and non-doubles.

Solution

Problem Set 2.4

1) Fourteen red marbles and sixteen green marbles are in a bag. Two marbles are picked out one at a time and replaced after they are picked. Build a tree diagram and probability model to show the different combinations of marbles that could be pulled out of the bag.

2) A bag contains a standard set of pool balls. Two balls are pulled out, one after another, and not replaced. What is the probability that the two balls are a solid and a striped ball in either order? (Recall that there are 8 solid pool balls and 7 striped pool balls.) [Perhaps draw a tree!]

3) A basketball player is practicing shooting free throws. Suppose she makes 75% of her free throw attempts. Make a tree diagram and probability model for what might happen if she decides to shoot three free throws. In other words, what is the probability that she makes zero shots, one shot, two shots, or all three shots.

4) A spinner with four evenly-spaced wedges of red, blue, green, and orange on it is spun and a coin is flipped. a) How many different outcomes are possible? b) Build a probability model that shows the probabilities for each outcome.

5) A baseball player is a .400 hitter. This means that he gets a hit 40% of the time he has an at-bat. Use a tree diagram to build a probability model that shows the probability of the player having 0, 1, 2, or 3 hits if he has 3 at-bats in one game.

6) In some sports, the home team wins a higher percentage of games played. Suppose the Dunkers and the Hoopsters are playing a best-of-three game series against each other. When the Dunkers are home, they have a 60% chance of winning a game against the Hoopsters. When the Hoopsters are home, they have a 55% chance of winning a game against the Dunkers. The Dunkers will be the home team in games 1 and 3 while the Hoopsters will be the home team in game 2. Use a tree diagram to build a probability model for this situation. The model should show the chances that the Dunkers win in 2 games or in 3 games and the chances that the Hoopsters win in 2 games or in 3 games.

7) A patient is scheduled to have two surgeries. The results of each surgery are independent of each other. Suppose the first surgery has a 90% success rate and the second surgery has an 85% success rate. Build a probability model by using a tree diagram that shows all the different results that might occur.

8) A bag contains ten red cubes numbered 1 through 10 and five blue cubes numbered 1 through 5. You pull two cubes out of the bag without replacement. What is the probability that the two cubes will be an odd cube and a red cube (in either order)?

9) A bag contains a $100 bill and two $20 bills. A second bag contains 1 gold marble and 2 silver marbles. You get to pick one bill out of the first bag. After this, you pick a marble out of the second bag. If you get the gold marble, you get to triple the amount of money you pulled from the first bag. If you get a silver marble, you get to double the amount of money you picked from the first bag. Build a probability model for all the different amounts of money that you might win.