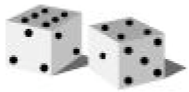

Activity 6 Becoming a Legend

Objectives

- Understand concept of probability
- Use case studies to understand real-life situations involving experimental probability
- Differentiate between risks based on skill and risks based on chance
- Compute combined probability

Materials	paper, pencils, calculators
Time	30 minutes
Math Idea	In the history of baseball, a season batting average of .400 has been one of the major achievements for a hitter to attain. Since 1941, Ted Williams is the only player to have hit .400.

Prior Understanding

Students should know how to convert among fractions, decimals, and percents. They should also know how to multiply and divide fractions and decimals.

Introduction

Use the following story as an introduction to the problem. Then have students do the activity.

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In 1941, Ted Williams, the legendary Red Sox slugger, was approaching the end of the season with a batting average just over .400. Williams risked falling below .400 if he played in both of the last two games. The coach offered to let Williams sit these games out. "I want to hit over .400," Williams said, according to Sports Illustrated. *"The record's no good unless it's made in all the games." Do you think Williams was taking a big risk by playing in all of the games?*

Discussion

Students' opinions will vary. Some may argue that because of his great skill and experience it was likely that he'd keep up his average. This is different from risks based solely on chance, like a coin toss.

Exercise 1

In baseball, batting average for a season is calculated by dividing the player's number of hits during the season by the number of times that the player has been at bat. By the end of the third from last game, Williams had 179 hits out of 448 times at bat. Have students calculate his batting average and use it to solve these problems.

- Find the **probability** that Williams would get 2 hits in two consecutive times at bat.
- Find how many hits Williams would be expected to get out of 8 times at bat (the number of times he could be up during a double-header).

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Discussion

Students should realize that a batting average is an **experimental probability**—it is based on previous occurrences, and as such, is only an estimate. There is no guarantee that future trials will follow the same pattern because the outcomes are not based only on chance but are also influenced by a player's skill. The greater the number of trials, the better the estimate. A player who gets 4 hits out of 10 times at bat has the same batting average as one who gets 40 hits out of 100 times at bat. However, the latter player's average is a better estimate of his or her ability. Williams' average of 179/448 = 0.39955 was a good indicator of his ability. Because batting averages are carried out to only three places, this batting average would round to.400.

Exercise 2

(a) Assuming Williams got that many hits on the last day of the season, have students determine what his final batting average would have been.

(b) Assuming Williams had 8 times at bat, have students determine how many hits he would have needed to finish with a .400 batting average or better.

(c) In the last two games, Williams got 6 hits out of 8 times at bat. Have students calculate his final batting average.

Discussion

The **combined probability** that Williams would get 2 hits in a row can be estimated by finding the product of the separate **probabilities**, or (.39955)(.39955) = .1596 or about 16%. In actuality, if he got a

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hit the first time, his batting average would go up slightly, but not enough to make a difference in the *estimate.*

Using his .39955 batting average, he would be expected to get $.39955 \times 8 \approx 3$ hits. (Students should solve the equation: $\frac{x}{8} = .39955$.) With 3 more hits, his average would have been 182/456 = .39912 or .399 (it would have gone down). With 4 hits, his average would have been 183/456 = .401, so he would have needed 4 hits out of 8 times at bat. His final average was

185/456 = .406.

Discuss with students whether they think it was wise for Williams to play, and what they would do if they were in a similar position.

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Activity 6 Becoming a Legend Teacher Support

Vocabulary

probability a number from 0 to 1 that expresses the likelihood that a given event (or set of outcomes) will occur

experimental probability probability determined by conducting a series of tests or trials and observing the number of favorable results compared to the total number of trials

combined probability the probability that two or more events will all occur

Ongoing Assessment

Out of 1,000 consecutive foul shots, a basketball player makes 698 of them. What is the probability that he or she will make two foul shots in a row? *(.698 × .698 = .487 or about 49%)* How many more shots must he or she make in a row to have a .700 average? *(7; students can solve the equation:* $\frac{698 + x}{1000 + x} = .700$ *)*

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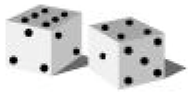

Added Practice 6 Becoming a Legend

Name ______________________________**Date**______________________

1. Your favorite basketball team is down by one point. Time has run out in the fourth quarter, and your team has a player at the foul line for two shots. You know that the player has made 80% of the foul shots he has taken this season. What is the probability that your team will win the game?

2. On Friday night, the weather forecaster says that there is a 99% chance of rain for Saturday. Saturday turns out to be a beautiful sunny day. Can you say that the weather forecaster's prediction was wrong? Why or why not?

3. Auto insurance companies base their rates according to the probability that a driver will have an accident during the course of a year. The probabilities that drivers of different ages will be involved in a crash are given in the table below.

Age group	Probability of being involved in a crash
Under 20	.153
21–24	.102
25–34	.073
35–44	.057
45–69	.046
Over 69	.040

According to the table, what is the probability that a driver under the age of 20 will be involved in a crash in two consecutive years? What is the probability that a driver between the ages of 45 and 69 will be involved in a crash in two

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consecutive years? Which driver do you think the insurance company will charge higher rates? Why?

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Answer Key Added Practice 6 Becoming a Legend

1. The probability that he will make the first shot is 80%, and the probability that he will make the second shot is 80%, so the probability that he will make both is .80 x .80 = .64. Your team has a 64% chance of winning.
2. You can't necessarily say that the weather forecaster is wrong. Weather predictions are based on experimental probabilities. With a 99% chance of rain, there is still a 1% chance of sun. No matter how probable rain is, it is still possible to get sun. In other words, a probability only tells you the likelihood of an outcome, not exactly what the outcome is going to be.
3. (.153)(.153) = .023 or 2.3%

   (.046)(.046) = .002 or 0.2%

   Insurance company would charge a driver under 20 higher rates because that driver is more likely to be involved in a crash that a driver between the ages of 45 and 69.

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