Lesson 14-5

Example 1 Experimental Probability

Dillon divided a spinner into 4 equal parts. He colored each part a different color (red, yellow, orange, and blue). He wanted to find the probability of the spinner landing on each color. He spun the spinner 20 times and recorded his results. He wasn't sure if his results were accurate so he spun the spinner another 20 times and recorded his results. Dillon performed this experiment a total of 3 times. The results of the experiment are shown in the table below.

Result	Experiment #1	Experiment #2	Experiment #3
Red	7	3	1
Yellow	6	5	4
Orange	4	6	5
Blue	3	6	8

What is the experimental probability that he spun orange in the first experiment?

In the first experiment, orange was spun 4 out of 20 times.

experimental probability = $\frac{4}{20}$ $\leftarrow$ frequency of spinning orange
$\leftarrow$ total number of spins

The experimental probability of spinning orange in experiment 1 is $\frac{4}{20}$ or 20%.

Example 2 Empirical Study

Refer to the table in Example 1. What is the experimental probability that orange was spun in all three experiments?

The number of successful outcomes of the three experiments was 4 + 6 + 5 or 15 out of 60 spins.

experimental probability = $\frac{15}{60}$ or $\frac{1}{4}$.

The experimental probability of the three experiments was $\frac{1}{4}$ or 25%.

Example 3 Simulation

A medication is predicted to work two out of three times.

a. What could be used to simulate the medication working?
You could used a die where the numbers 1, 2, 3, and 4 represent the medication working.

b. Describe a way to simulate the effectiveness of the medication on 10 people.
Roll the die once to simulate one person's chance of the medication working. Record the result, then repeat this 9 more times.

Example 4 Theoretical and Experimental Probability

Kelly is taking a 5 question multiple choice test. Each question has 3 possible answers, *A*, *B*, or *C*. Kelly would like to figure out the most likely mix of answers. Assume that *P*(*A*) = *P*(*B*) = *P*(*C*) = $\frac{1}{3}$.

a. What objects can be used to model the possible outcomes of the answers?

Each answer can be *A*, *B*, or *C*, so there are $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$ or 243 possible outcomes for the test. Use a simulation that also has 3 outcomes for each of the 5 events. One possible simulation would be to place 3 slips of paper into a hat. One would be labeled *A*, one labeled *B*, and the last one labeled *C*. For each question, you would choose one slip of paper, record your answer and replace it.

b. Find the theoretical probability that there will be all *A*'s.

There are 243 possible outcomes, and the number of combinations that have all A's is ${}_5C_5$ or 1. So the theoretical probability is $\frac{1}{243}$.

c. The results of a simulation Kelly performed are shown in the table. What is the experimental probability that there will be 4 *B*'s? How does this compare to the theoretical probability of there being 4 *B*'s?

Kelly performed 50 trials and of those 2 resulted in 4 *B*'s.

So, the experimental probability is $\frac{2}{50}$ or 4%.

compare this result to the theoretical probability.

$P(4\ B\text{'s}) = \frac{{}_5C_4}{243}$ ← combinations with 4 *B*'s
← possible outcomes

$= \frac{5}{243}$ or 2%

The experimental probability is very close to the theoretical probability.

Outcomes	Frequency
1 A, 4 C	1
1 A, 4 B	1
1 A, 3 C, 1 B	4
1 A, 3 B, 1 C	4
1 A, 2 C, 2 B	5
1 B, 4 C	3
1 B, 4 A	4
1 B, 3 C, 1 A	4
1 B, 3 A, 1 C	4
1 B, 2 C, 2 A	6
1 C, 4 A	1
1 C, 4 B	1
1 C, 3 A, 1 B	4
1 C, 3 B, 1 A	3
1 C, 2 A, 2 B	5