Law of Large Numbers

Strand: Data Analysis

Topic: Probability

Primary SOL: AFDA.6 The student will calculate probabilities. Key concepts include
e) Law of Large Numbers.

Related SOL: AFDA.8

Materials

- Law of Large Numbers activity sheet (attached)
- Spinner (physical or digital)

Vocabulary

conditional probability, experimental probability, Fundamental Counting Principle, Law of Large Numbers, probability, relative frequency, sample space

Student/Teacher Actions

Time: 30 minutes

Have students complete the Law of Large Numbers activity sheet. At the end of the investigation, discuss students' conclusions from the last step. Be sure that everyone understands that as a procedure is repeated, the relative frequency probability of an event tends to approach the actual probability.

Assessment

- **Questions**
  - What are some reasons why the theoretical and experimental probabilities may differ from each other?
  - Explain the relationship between experimental and theoretical probabilities.
- **Journal/writing prompts**
  - Determine the percentage of students who are male compared to female in your school. Explain why this percentage may differ from 50-50.
  - Have students discuss how theoretical probabilities can be used to estimate the actual probabilities of a large data set. Explain the pros and cons of using the Law of Large Numbers.
- **Other Assessments**
  - Have students design a practical experiment with a theoretical probability that can be easily determined (i.e., coin toss) and determine how close the experimental probability is to the theoretical probability.

Extensions and Connections

- Have students look up statistics on male and female births in the United States or worldwide to determine how close the theoretical and experimental probabilities match.
- Have students keep track of, as a class, the theoretical probabilities of rain occurring the next day and how they differ or correlate with actual experimental days of rain.

Strategies for Differentiation

- Have students use a physical spinner instead of a digital spinner to visualize the inconsistencies in the spinner that lead to a difference between theoretical and experimental probabilities.
- Use vocabulary cards for related vocabulary listed above.
- Have students use a digital tally program or application to gather data for experiments.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Law of Large Numbers

Use a spinner (simulator on a calculator or computer). Set the number of sections on the spinner to 5. Change one of the actual (theoretical) values to 50 percent.

1. What has to be true of the other four actual (theoretical) values?

2. What happened to the appearance of the spinner?

Select any five probability values that you would like. Record these actual (theoretical) probability values as percentages.

Section:	1	2	3	4	5
3. Theoretical Values	_____	_____	_____	_____	_____

4. Record the experimental probability (relative frequency) as a percentage.

After 1 spin	_____	_____	_____	_____	_____
After 2 spins	_____	_____	_____	_____	_____
After 5 spins	_____	_____	_____	_____	_____
After 10 spins	_____	_____	_____	_____	_____

Change the trial set or number of spins to 10.

After 20 spins	_____	_____	_____	_____	_____

5. Compare the relative frequency (experimental) probabilities in step 4 with the actual (theoretical) probabilities from step 3. Are you surprised by your results? Why or why not?

6. How many spins do you think it will take for the two types of probabilities to be equal? Explain.

7. Record the probability from relative frequency.

After 30 spins	______	______	______	______	______
After 40 spins	______	______	______	______	______
After 50 spins	______	______	______	______	______
After 100 spins	______	______	______	______	______

8. Change the trial set or number of spins to 100. Record.

After 200 spins	______	______	______	______	______
After 300 spins	______	______	______	______	______
After 400 spins	______	______	______	______	______
After 500 spins	______	______	______	______	______

9. Change the trial set or number of spins to 500.

After 1,000 spins	_____	_____	_____	_____	_____
After 2,000 spins	_____	_____	_____	_____	_____
After 3,000 spins	_____	_____	_____	_____	_____

10. Round each of your relative frequency (experimental) probabilities from 3,000 spins to the nearest whole percentage.

_____ _____ _____ _____ _____

11. Copy your actual (theoretical) probabilities from step 3.

_____ _____ _____ _____ _____

12. Compare the relative frequency (experimental) probabilities in step 10 with the actual (theoretical) probabilities from step 11.

13. Look at the results from three other people. What conclusion can you make about the relationship between relative frequency probability and actual probability as the number of experiments increases?