Introduction to Probability
A Closer Look at the Video

After watching the *Introduction to Probability* video, make sense of the mathematics by reading through the problem situation and solution. Use the comments and questions in bold to help you understand probability.

Problem: Cameron and a few friends have gotten together for Board Game night. They are playing Probability Path. The goal of the game is to be the first to move a piece along a winding path to the finish. The spinner determines how far you move. Who wins is just a matter of chance. Cameron and her friends want to know the probabilities of spinning particular numbers to determine the likelihood of different people winning the game.

Board Game:

Spinner:

The following rules are important to understanding probability.

1. Probability deals with future events.
2. Probability can be expressed as a percent from 0 to 100% or as a rational number from 0 to 1.
3. The probability of a certain event is 1 or 100%. The probability of an impossible event is 0 or 0%.
4. The sum of the probabilities of all possible outcomes is 1 or 100%.

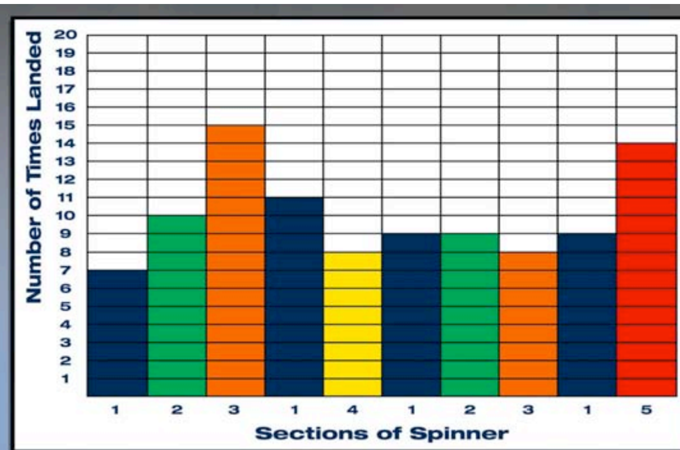
Shea has been doing well. If she spins a five, she will win. How likely is it that Shea will spin a five on her next turn? First, look at the spinner. Which numbers are more likely than others?
There are 10 possible outcomes. There are 4 ones, 2 twos, 2 threes, 1 four, and 1 five. Together they represent all the possible outcomes. This is called the sample space. It looks

like Shea is more likely to spin a one than any other number. This is because the spinner has 4 ones. She is more likely to spin two or three than four or five because there are more twos and threes than fours and fives on the spinner.

By collecting data, we can find the experimental probability. It's impossible to determine probability after just one spin. A larger number of spins will give us more accurate results.

The results for 100 spins is shown in the table and graph below.

EVENT	SPINS OUT OF 100
1	36
2	19
3	23
4	8
5	14



What is the experimental probability of spinning a 1?
If you consider all four ways to spin a one, out of 100 spins the table and graph show we got a one 36 times. The result was one 36% of the time. The experimental probability of spinning a one is $\frac{36}{100}$.

What do the numerator and denominator of the fraction in the preceding statement represent?
The numerator represents the number of times the result was 1; the denominator represents the total number of spins.

We just determined the probability of spinning each number with an experiment. What is another way we could determine the probabilities of spinning each number?
We could also determine the probability by analyzing the actual spinner. The spinner is divided into 10 equal sections. Four sections of the spinner show 1. In theory, we should expect to spin a 1 four times in ten spins. That's $\frac{4}{10}$ or 40% of the time. This is the theoretical probability of spinning a 1. The theoretical probabilities of spinning a 2, 3, 4, and 5 are shown

in the table below. Notice, the experimental and theoretical probabilities are close but not exactly the same.

EVENT	SPINS OUT OF 100	EXPERIMENTAL PROBABILITY	THEORETICAL PROBABILITY
1	36	$\frac{36}{100}$ OR 36%	$\frac{4}{10}$ OR 40%
2	19	$\frac{19}{100}$ OR 19%	$\frac{2}{10}$ OR 20%
3	23	$\frac{23}{100}$ OR 23%	$\frac{2}{10}$ OR 20%
4	8	$\frac{8}{100}$ OR 8%	$\frac{1}{10}$ OR 10%
5	14	$\frac{14}{100}$ OR 14%	$\frac{1}{10}$ OR 10%

Imagine spinning the spinner 1000 times or 10,000 times. How should the experimental and theoretical probabilities compare as the number of spins increases?
The more spins or trials there are, the closer the experimental probability should be to the theoretical probability.

EVENT	EXPERIMENTAL PROBABILITY 100 SPINS	EXPERIMENTAL PROBABILITY 1000 SPINS	EXPERIMENTAL PROBABILITY 10,000 SPINS	THEORETICAL PROBABILITY
1	36%	42.5%	40.21%	40%
2	19%	17.7%	19.82%	20%
3	23%	18.4%	19.96%	20%
4	8%	10.5%	10.13%	10%
5	14%	10.9%	9.88%	10%

Answer the following questions by determining the theoretical probability.

Allie is six places away from the finish. What is the probability of her spinning a 6 and winning on this round?
There isn't a 6 on the spinner, so this is an impossible event. The probability of spinning 6 is 0, or 0%.

Tina is one place from the finish. What is the probability that Tina will finish the game on the next turn if she needs at least a 1?
Any number on the spinner will give her the one space she needs, so this is a certain event. The probability of spinning 1 or greater is 1, or 100%.

Lexi isn't doing very well. She has spun a 2 the last five times. What is the probability she will spin a 2 on her next turn?
Each spin is independent from the others. No matter how many times Lexi has already spun a 2, there is still a 20% probability that she will spin a 2 on her next turn.

Allie hasn't spun a 2 the entire game. What is the probability she will spin a 2 on her next turn?
The probability that she will spin a 2 is the same as the probability that anyone else who is playing the game will spin a 2. As is the case for Lexi, the probability that Allie will spin a 2 is $\frac{2}{10}$, or 20%.

If Kyle spins a 2, he will have to go back ten spaces. What is the probability of him not spinning a 2?
Since we know the probability of spinning a 2 is 20%, the probability of Kyle not spinning a 2 is 100% – 20%, or 80%.

You can estimate probability by gathering data from an experiment (experimental probability) or determine probability by analyzing outcomes (theoretical probability). Remember, if you use an experiment, the larger the number of trials the better the estimate.