8.1 Theoretical and Experimental Probability

LT8.1: I can use experimental probabilities to make predictions and justify conclusions.

Probability is the chance that an event will occur. It is calculated by dividing the number of ways the event can occur by the sample space (the total number of possible outcomes).

$$Probability = \frac{\#\ of\ ways\ an\ event\ can\ occur}{sample\ space}$$

Example: A bag contains 2 Red Marbles, 3 Blue Marbles, and 4 Green Marbles. What is the probability that someone will reach in and pull out a red marble at random?

To find this, we need to look at two things:

1) The number of ways the event can occur. In this case, the event is pulling a red marble. Since there are 2 red marbles, this event can occur 2 ways.

2) The sample space. This is the total number of marbles that could be pulled out. Since there are 2 + 3 + 4 = 9 marbles total, the sample space is 9.

$$Probability = \frac{2}{9}$$

Experimental Probability is like Theoretical Probability, but the number of ways an event can occur is not known. Rather, surveys or tests are done to make estimates.

For example, if a student rolls a 6-sided die 6 times, he could have the following outcomes:

No 1's, one 2, one 3, three 4's, no 5's, and one 6.

In this case, the experimental probability is the number of times the student rolled the die divided by the number of die rolls. So the experimental probability of rolling a 4 is 3/6, or 50%. We know that it's not "normal" to roll a 6-sided die and get a 4 50% of the time because each of the numbers on a die has a theoretical probability of 1/6.

The Law of Large Numbers tells us that if we continued to increase our sample size (have more and more trials), then the experimental probability (the probability we observe through the trials) will get closer to the theoretical probability (what we would expect to happen).

Experimental probability is used for making educated guesses about larger sample sizes when the theoretical probability is not known. An example would be taking a survey of students in South High School

about their thoughts on a social justice issue. There is no theoretical probability for this; in other words, we don't know how students "should" respond to the questions. So we can do a survey, and based on the responses of a group of students, have an educated guess about what the whole school thinks of the issues.
