Unit 7, Lesson 8

Not Always Ideal

Let's see how closely data matches expectations.

8.1 When Does It Get Weird?

Lin, Kiran, and Diego are each going to shoot 100 free throws for practice. Based on their shooting in the past, Lin thinks they are all of similar ability, and Lin estimates that they each have a 60% chance of making each shot. They all shoot their shots.

- Lin makes 63 of the 100 shots.
- Kiran makes 75 of the 100 shots.
- Diego makes 35 of the 100 shots.

From the results, do you agree with Lin's estimate for the chance of each person making each shot? Explain your reasoning.

8.2 What Is Reasonable?

1. What is the probability that the coin you will flip lands showing heads?

2. Estimate the number of heads you will get when you flip the coin 20 times.

3. Flip your coin 20 times, and record the number of heads you get. Repeat this process as much as you can until your teacher pauses the class.

trial number	1	2	3	4	5
number of heads					

4. Create a dot plot that shows the number of heads in 20 flips, using data from the class.

5. What is the fewest number of heads flipped by the class in 20 flips? What is the greatest number of heads flipped by the class in 20 flips?

6. Based on the class dot plot, describe a range of values that represent a reasonable number of heads to flip when flipping 20 times.

7. Priya flips her coin 20 times, and it lands showing heads 2 times.
   a. Is it possible for this to happen with a fair coin?

   b. Based on the class distribution, should she be suspicious of this being an unfair coin? What can she do to provide evidence that it's not a fair coin?

Are you ready for more?

This time, instead of flipping the coin 20 times and counting how many heads result, consider how many coin flips it takes to get a heads.

1. Before flipping, estimate the average number of flips it will take to get your first heads.
2. Flip! Record how many flips it takes to get your first heads. Then start again and record how many flips it takes to get your next heads. Keep flipping and recording how many flips it takes to get successive heads, until you get 30 heads. Create a dot plot that shows how many flips it took each time to get a heads, and compute the mean number of times it took.



3. Based on the dot plot, describe a range of values that represents a reasonable number of coin flips it takes to get a heads.

8.3 Is That Fair?

The local news station wants to interview 8 students from a school. There are 25 students on the student council. Ten of the students are from the graduating class, and 15 are from the other classes. The principal has a difficult time deciding which students from the council to interview, so she tells the group of students that she will put all of the names in a bowl, mix the names, then the first 8 names who are selected from the bowl will get interviewed.

The next day, the principal returns with the names selected. It turns out that 5 of the students who get to be interviewed are in the graduating class and only 3 of the students selected are from other classes. The students who are not in the graduating class complain that this doesn't seem fair. They suspect that the principal chose the group rather than selecting at random.

1. Do you think the principal could have chosen this group of students at random like she promised? Explain your reasoning.

2. Simulate the drawing many times to find some possible results.

   a. Cut a piece of paper into 25 equal-sized pieces. On 10 of the pieces of paper, write "graduating class." On the other 15 pieces of paper, write "other classes." Fold the papers in half, and mix them up.

   b. Take turns with your partner to draw 8 pieces of paper and record the number of students chosen that are in the graduating class.

   c. Repeat this process 4 more times.

drawing number	1	2	3	4	5
number of students in the graduating class					

3. Create a dot plot that shows the data from all of the students in your class.

4. Based on the dot plot, do you think it is reasonable that the principal selected the students for the interview at random and still chose 5 students who are in the graduating class out of the 8 total? Explain your reasoning.

Lesson 8 Summary

Mathematics can often provide a model for a situation so that estimates and predictions can be made, but it is rare for the actual results to match predictions exactly. A single result that differs from the model slightly should not invalidate the model, but if many results are different from a model or if results tend to be drastically different, then the model may not do a good job of approximating the situation.

For example, imagine flipping a coin 100 times. Since the probability of a flipped coin landing heads up is $\frac{1}{2}$, we might expect 50 of the flips to land heads up. This is a good expectation, but it should not be surprising if 45 or 57 of the flips are heads. On the other hand, if 95 of the flips are heads, we might become suspicious of the $\frac{1}{2}$ probability applying to this coin. Or, if the process of flipping the coin 100 times is repeated 100,000 times and the mean number of heads around 45, then maybe the assumption that the coin is fairly balanced to result in heads 50% of the time is incorrect and the model should be adjusted accordingly.

A good mathematician will often use data to suggest a model that can approximate a situation, then reevaluate the model by testing it against additional data. The model is then improved with the additional information to more closely mimic reality. This process may need to be revisited several times until its accuracy is satisfactory.