The Law of Averages

**Scenario**

Have you ever heard someone say something about “the law of averages”? 

- Disobey the law of averages. Let others take the traditional course. We prefer creativity over conformity. Invention over imitation. Inspired ideas over tired ideas. In short, Audi offers an alternative route.  
  *(from a print ad for Audi)*

- President Ronald Regan explained why he thought there was corruption in the Pentagon’s purchasing process: “The law of averages says that not all 6 million are going to turn out to be heroes.”  
  *(Pittsburg Press, June 18, 1988)*

- According to Tom Arnold on his TV show, “As many times as she’s been guilty before, she has to be innocent this time – it’s the law of averages.”  
  *(Tom Arnold on the Tom Arnold Show, March 9, 1994)*

- According to the Oxford American Dictionary; the Law of averages is defined as “the proposition that the occurrence of one extreme will be matched by that of the other extreme so as to maintain the normal average”.  
  *(Oxford American Dictionary, 1980)*

**Question**

What do we really mean by the Law of Averages?

**Objectives**

In this lesson, you will take a look at quotes from a variety of sources all found using the phrase “law of averages” either correctly or incorrectly in reference to probability. After analyzing these statements, you will try to connect the law of large numbers to a correct interpretation of probability.

**Activity**

1. **Categorize Statements**
   
   a. Read each of the statements from the resource page your instructor will give to you and try to determine what popular usage for the law of averages these statements belong in. The categories are:

   1. **If given enough opportunities, even unlikely events must eventually happen.**  
      *(ie: President Regan’s Statement)*

   2. **If an event has not happened on several previous opportunities, it is much more probable that it will happen on the next chance.**  
      *(ie: Tom Arnold’s Statement)*

   3. **Events seems to “even out” to maintain some kind of “normal average”.**  
      *(ie: Oxford Dictionary’s definition)*
2. **Determine which category gives the correct interpretation probability.**
   After discussing the statements from the resource page, and determining which category they fit into, answer the question – Which of categories (one, two or all three) gives the correct understanding of the concepts learned about probability.

3. How many heads would you expect to have after 10 flips of a fair coin?
   (“Expect” is a mathematical term that means about the same as “average”. This, then means, “on the average, how many heads do people get after flipping a coin 10 times?”)

4. How many heads would you expect to have after 50 flips of the coin?

5. Look at this sequence of coin tosses (of a fair coin) and then answer a few questions:
   

   - In the sequence above, what is the actual number of heads after 10 flips? What is the percentage of heads after 10 flips?
   - In the sequence above, what is the actual number of heads after 50 flips? What percentage is the heads after 50 flips?

   It is counterintuitive, but as the percentage of heads gets closer to 50% the actual number of heads gets further away from half of the total number of flips. In fact, the Law of large numbers tells us that this is what we should expect.

   **The Law of Large Numbers says that as a fair coin is flipped more and more times;**
   - the percentage of heads approaches 50% (the theoretical probability)
   - the number of heads tend to swing more and more wildly about the expected number of heads (which is half of the total number of flips).

6. At a carnival game, you will win a prize if you can toss a fair coin and get somewhere between 40% and 60% heads. Whould you rather toss the coin 10 times or 100 times?

7. If you had to toss the coin and get exactly 50% heads would you rather toss the coin 10 times or 100 times?

8. You plan to toss a coin many times as part of an experiment in stats class and the first two tosses are both heads. If you continue to toss the coin what do you expect;
   a. Is the next coin toss more likely to be a head or a tail?
   b. How many heads do you expect to have after you have completed 10 total tosses (remeber you have already tossed it twice)? What is the expected percentage after 10 tosses ?
   c. How many heads do you expect to have after you have completed 1,000 total tosses (remeber you have already tossed it twice)? What is the expected percentage after 1,000 tosses ?

**Wrap up**

Chick Hearn, the legendary broadcaster of the Los Angeles Laker noted during a game that Magic Johnson had made the last six out of six free throws. As magic comes to the line for his seventh attempt, Chick concludes that “the law of averages starts working for Golden State”. What does Chick Hearn mean? Is this a correct interpretation of probability?