Law of Large Numbers — Math 111

1. **Roulette** Suppose that you play roulette 1,000 times. Each time you play, you bet \$1 on black. Suppose that you win 470 times and lose the other 530 times. Recall, if it lands on black you get \$2, and if it doesn't you get \$0.

   (a) How much money have you won in total playing roulette? Is this more or less than the \$1,000 you paid to play that many games?

   (b) How much money have you won on average per game?

   (c) What is the expected value of a game of roulette?

2. If you flip a coin 100 times and get 80 heads, what is the average number of heads per flip?

3. **Law of Large Numbers** Which would be more surprising, to flip a coin 100 times and get 80 heads or to flip a coin 1000 times and get 800 heads? Explain.

4. If you play roulette but bet on one number (say 7), the casino pays you back $36 for every dollar you bet, if you win. Your probability of winning is only 1 out of 38. What is the expected value of this bet?

5. Which is a better bet, betting on a single number or betting on a color (red or black)?

6. At one casino, there are around 5000 people playing roulette every night. If each person bets an average of $100 each night, then use conversion factors to estimate how much money the casino will give back to the gamblers, on average?

7. How much money will the casino take in from the gamblers?

8. What is the casino's average nightly profit from the roulette tables?

9. Assuming the casino is open 365 days per year, what is the casino's average annual profit?

10. **Law of Large Numbers, part 2** Which is more unusual, that five friends at a casino would win all win money on a trip to Vegas, or that a Vegas casino would lose money?