

## P Chapter 5 Project

### Playing Roulette

We all dream of winning big, becoming an instant millionaire; but how likely is that? Let's say we decide to pursue our goal of winning big money by going to a casino and continually playing what we think will be an easy game: roulette. Can we expect to win big in the long run? Is one bet better than another? How do the casinos make so much money anyway? If we are betting against the casino, how do they make sure that they always win? This project will help you answer these questions.

Let's begin with a lesson in roulette. Roulette is a casino game that involves spinning a ball on a wheel that is marked with numbered squares that are red, black, or green. Half of the numbers 1–36 are colored red and half are black and the numbers 0 and 00 are green. Each number occurs only once on the wheel.

We can make many different types of bets, but two of the most common are to bet on a single number (1–36) or to bet on a color (either red or black). These will be the two bets we will consider in this project. After all players place their bets on the table, the wheel is spun and the ball tossed onto the wheel. The pocket in which the ball lands on the wheel determines the winning number and color. The ball can land on only one color and number at a time.

We begin by placing a bet on a number between 1 and 36. This bet pays 36 to 1 in most casinos, which means we will be paid \$36 for each \$1 we bet on the winning number. If we lose, we simply lose whatever amount of money we bet.

1. Calculate the probability that we will win on a single spin of the wheel.
2. Calculate the probability that we will lose.
3. If we bet \$8 on the winning number, how much money will we win?
4. What is the expected value of a bet on a single number if we bet \$1?
5. For a \$5 bet, what is the expected value of a bet on a single number?
6. What is the expected value of a bet on a single number if we bet \$10?
7. Do you see a pattern in the answers to the last three questions?

We decide that we can certainly increase our chances of winning if we bet on a color instead of a number. Roulette allows us to bet on either red or black and if the number is that color, we win. This bet pays even money in most casinos. This means that for each dollar we bet, we will win \$1 for choosing the winning color. So, if we bet \$5 and win, we would keep our \$5 and win \$5 more. If we lose, we lose whatever amount of money we bet, just as before.

8. What is the probability that we will win on a single spin if we bet on red?
9. What is the probability that we will lose on a single spin if we bet on red?
10. If we bet \$60 on the winning color, how much money will we win? Is this more or less than we will win by betting \$8 on our favorite number? Explain why.
11. What is the expected value of a bet on red if we bet \$1?
12. For a \$5 bet, what is the expected value of a bet on red?
13. What is the expected value of a bet on red if we bet \$10?
14. Do you see a pattern in the answers to the last three questions?
15. How does the expected value of betting on a number compare to the expected value of betting on a color? Is one bet more profitable than another?
16. If our goal was to play roulette so that we can “win it big,” what does the expected value of a bet tell us about our chances of winning a large amount of money?
17. Are the casinos really gambling when we place a bet against them? Explain.