

## I. Roulette

In the game of roulette, a small ball randomly lands in any one of 38 pockets on a roulette wheel. The ball can land in any pocket with equal likelihood. These pockets are marked with the numbers 0, 00, and 1-36. Half of the pockets numbered 1-36 are black, while the other half are red. The 0 and 00 are green.

1. The house pays 35:1 for betting and winning on a single number on the wheel.
  - (a) What is the probability of such an event?
  - (b) What are the odds against such an event?
  - (c) For a \$1 bet, what is the expected value of the above event? What is the significance of the sign of the expected value?
  - (d) Considering the above answers, why does the house only pay 35:1?
  
2. The house pays 1:1 for betting and winning on a single color (red/black) on the wheel.
  - (a) What is the probability of such an event?
  - (b) What are the odds against such an event?
  - (c) For a \$1 bet, what is the expected value of the above event? Who does the expected value favor, the player or the house?
  - (d) Considering the above answers, why does the house only pay 1:1?

## II. Craps

The game of craps is played with two, six-sided dice. (The basic rules of the game can be found in a separate handout.) While the rules are straightforward, the betting can be very complicated because there are so many options, and because each round of play can involve several rolls of the dice. Here we consider only the simplest situation, the Pass Line bet.

1. Consider the come-out roll.
  - (a) Calculate the probability of rolling a natural (7 or 11) on the come-out roll, which wins the Pass Line bet.
  - (b) Calculate the probability of rolling craps (2, 3, or 12) on the come-out roll, which loses the Pass Line bet.
  - (c) Calculate the probability of rolling a point (4, 5, 6, 8, 9, or 10) on the come-out roll and thus being required to roll again.
  - (d) Based on the above calculations, who seems to have the advantage for a Pass Line bet, the player or the house?
2. Suppose a point was rolled on the come-out roll.
  - (a) For each possible point (4, 5, 6, 8, 9, or 10), calculate the probability of winning the Pass Line bet on the second roll by rolling the given point.
  - (b) Calculate the probability of losing the Pass Line bet by rolling a 7 on the second roll.
  - (c) For each possible point (4, 5, 6, 8, 9, or 10), calculate the probability of rolling neither the point nor a 7 and thus being required to roll again.
  - (d) Based on the above calculations, who seems to have the advantage for a Pass Line bet on the second roll, the player or the house?
3. Consider the above two problems.
  - (a) Is there only a finite number of ways for a game of craps to end?
  - (b) Considering the game as a whole, do you think it is equally likely to roll a given point on a fifth roll than on a second roll?
  - (c) Do you think the methods for calculating probability that were presented in this class are sufficient to fully analyze the Pass Line bet in the game of craps? Why or why not?
  - (d) Who do you think actually has the overall advantage, the player or the house?