

# MATH 157: Mathematics in the world

## Notes 13 (March 12, 2019)

### 1 Market making

#### 1 - Rolling 3 dice

We are going to play a game: you roll three dice and you are paid back the product of the three outcomes.

#### 2 - Dice game

We are going to play a game rolling a fair die; after a roll, you can decide to cash in a number of dollars equal to the outcome of the die, or to roll the die again (and forget about the previous outcome).

- You are allowed to roll the die at most 3 times?
- You are allowed to roll the die at most  $n$  times?
- You can roll the die as many times as you want?

#### 3 - Casino game

We are going to play the following game. We will start by showing the cards of a deck (well shuffled) one by one. At any point, you can stop and cash in  $B - R$  dollars, where  $B$  is the number of black cards that have been shown, and  $R$  is the number of red cards that have been shown.

- The deck consists of 2 blacks and 1 reds.
- The deck consists of 1 blacks and 2 reds.
- The deck consists of 2 blacks and 2 reds.
- The deck consists of 3 blacks and 3 reds.

#### 4 - H/T game

We are going to play the following game. Each of us simultaneously show a coin with either head side up or tail side up. If we both show heads, then you will get 3.5. If we both show tails, then you will get 1. If we show different sides, then you will lose 2.

## 5 - Another dice game

We are going to play another game rolling a fair die; this time you can roll it as many times as you want. The rules are: if you get a six, the game stop and you win nothing; otherwise, you can stop at any moment and win the sum of all the previous outcomes of the die.

## Betting strategy

### 6 - Betting on fair dice

We are going to play a game throwing a fair die; after a throw, the payback for odd is 3 : 2 (i.e, if you bet 2 on odd, then you will get  $5 = 3 + 2$  back if the die turns out to be an even number, and 0 back if the die turns out to be an odd number), and the payback for even is 4 : 5. You are allowed to bet on both sides. How would you bet on this game?

### 7 - World series

We are going to bet on the World Series between Red Sox and Yankees. You want to bet on the Red Sox (of course!) winning the series. Unfortunately, you can only bet on individual games of the series (up to 7 games are played, and when a team wins 4 the series stops with a winner); how should you place your bets?