Lesson 7: Let's Gamble

1 Roulette and the martingale betting system

Roulette is a casino game that consists of a wheel whose outer ring is divided into 38 slots. The wheel is spun in one direction and a small ball is rolled in the opposite direction. When the wheel comes to rest the ball falls randomly into one of the 38 slots.

The slots on the roulette wheel are numbered from 1 to 36, plus 0 and 00. There are many different ways a player can place a bet. For our purposes we will consider one of the most simple options: The player bets that the ball will land on one of the even numbers $2, 4, \ldots, 36$. This type of bet has a one–to–one payout. In other words, with a \$5 bet, the player will win \$5 if the ball lands on an even number, and lose \$5 if the ball lands on an odd number or 0 or 00. The odds of winning a single bet are 18/38, slightly less than 50%.

The martingale betting system is a scheme that appears to allow the player to "beat the odds". Here is the idea. The player plays repeated rounds, staring with an initial bet of, say, \$2. (This is the minimum bet in many Las Vegas casinos.) Every time the player loses, he/she doubles the bet and plays again. Every time the player wins, he/she starts over with the initial bet.

> Exercise I: Explain how the martingale system works. Does it really guarantee that the player will win in the long run?

2 Simulated gambling

Before you empty your bank account and rush off to Las Vegas, you might want to test the martingale betting system with some computer similations. You will need to simulate the random outcome using one of the built–in random number generators in `numpy` or `pylab`.

Homework: Write a code to simulate a player who plays roulette, bets on "even", and uses the martingale betting system. You should assume that the minimum bet is $2. The player is not infinitely wealthy; he/she walks into the casino with, say, $20 to gamble. The output of your code should look something like this:

```
your bet is  2
ball lands on  12
you win 2, you have 22 dollars

your bet is  2
ball lands on  22
you win 2, you have 24 dollars

your bet is  2
ball lands on  19
you lose 2, you have 22 dollars

your bet is  4
ball lands on  15
you lose 4, you have 18 dollars

your bet is  8
ball lands on  00
you lose 8, you have 10 dollars

your bet is  10
ball lands on  27
you lose 10, you have 0 dollars

Sorry, you are bankrupt
```

Note that the simulated player doubles the bet with each loss, as long as he/she has enough money to do so. If not, the player just bets as much as possible. The play stops if the player is bankrupt. Let's also assume that the player is not greedy; the goal is simply to double his/her money (from, say, $20 to $40). Write your code such that the play stops if the player's money is doubled, and says `Congratulations, you doubled your money`.

Your LaTeX document should include a copy of your code, as well as a brief explanation of the logic of the code.