CS7637 project1(martingale) report

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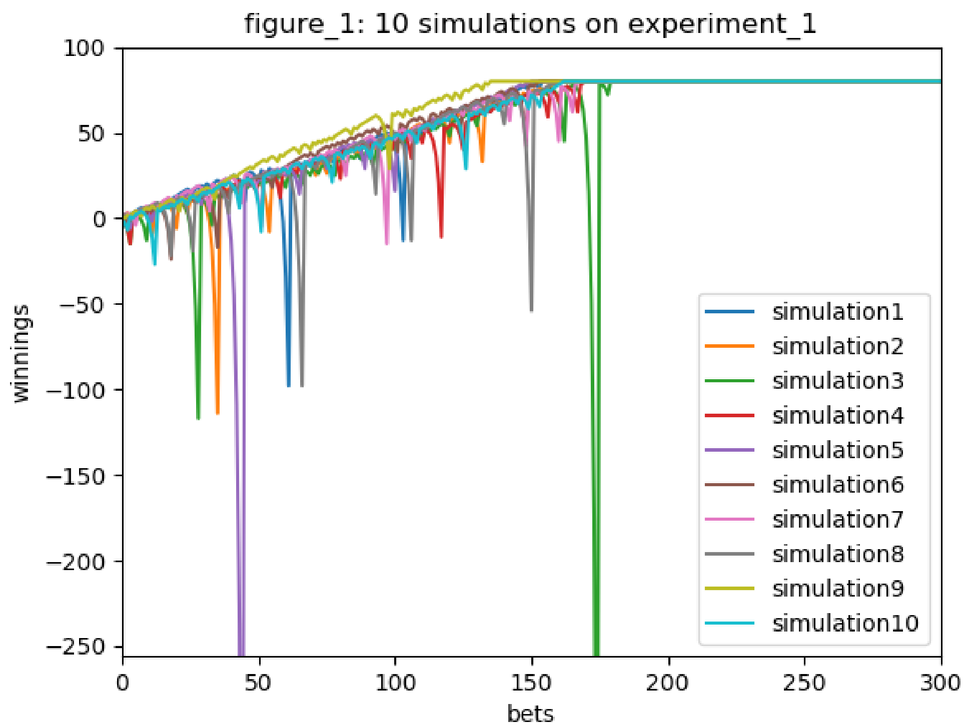
Question 1

Out of my 1000 Monte Carlo simulations, all simulations reached a winning of $80. Therefore, my estimated probability of winning $80 within 1000 bets is 1.

It makes sense intuitively.

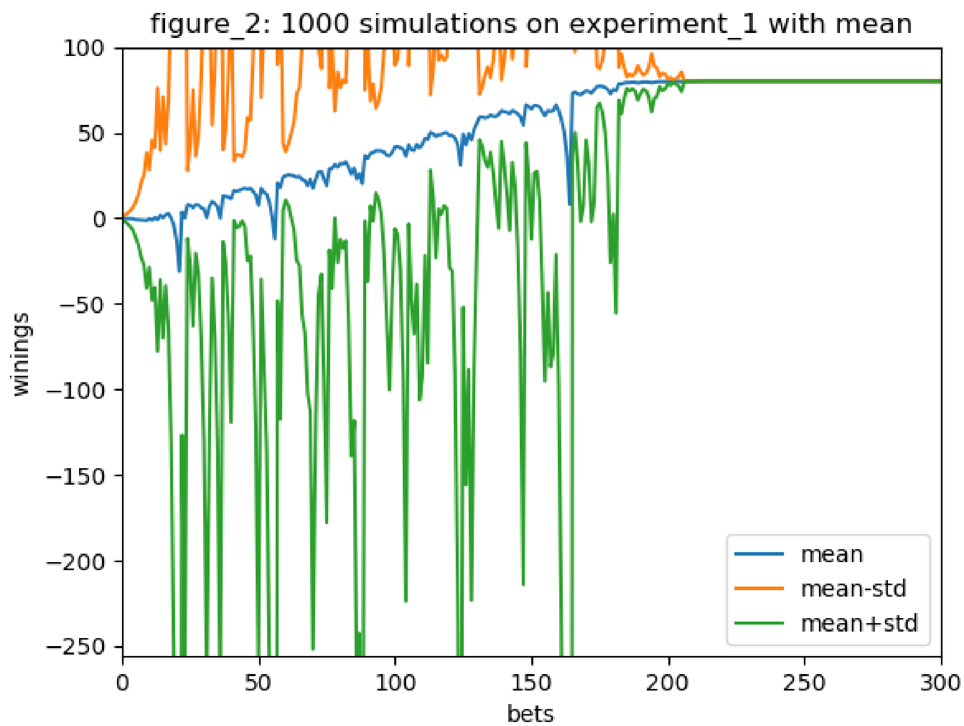
- Because of the martingale strategy, even if you already lose a lot already, as long as you win next time, you will instantly win back.
- Since an agent would stop at winning $80, the only scenario that an agent doesn't win $80 within 1000 bets is that the agent is losing all the 1000 bets.
- The probability of losing 1000 bets continuously is the losing probability (20/38) to the power of 1000, which is almost 0.
- Therefore, the probability of winning $80 within 1000 bets is almost 1.



Question 2

If we take the average winning of all 1000 simulations, we will have \$80. Therefore, by the method of moments, \$80 would be my estimate of the expected value of winnings after 1000 sequential bets.

The visualization also verifies this claim: in Figure 2, the mean flats out at \$80 quickly before 200 bets; this implies that everyone will win \$80 eventually within 1000 bets.



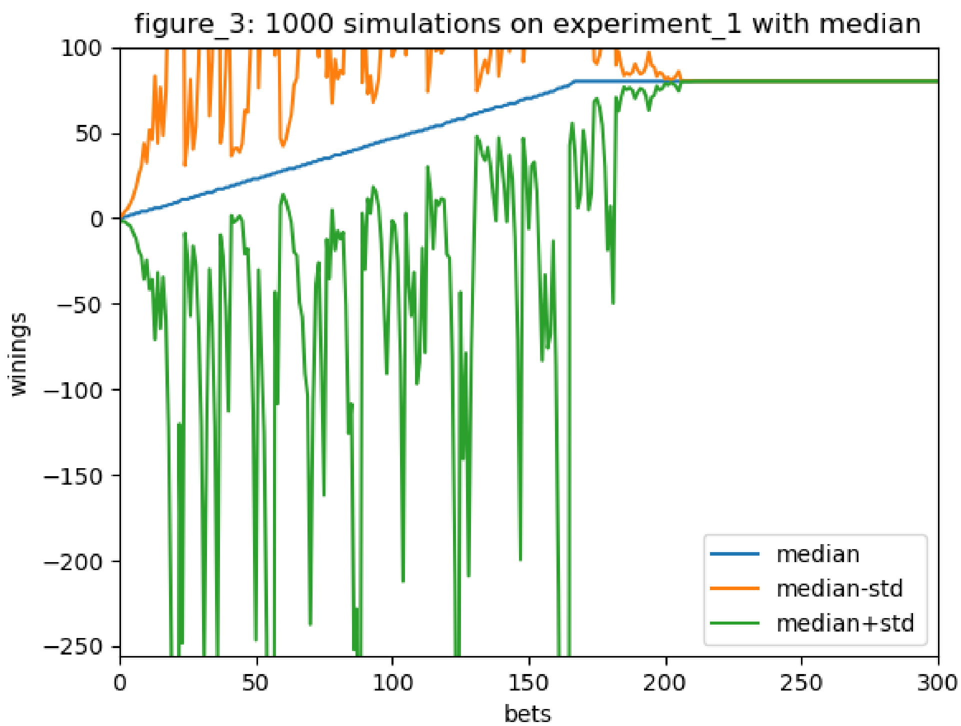
Question 3

Yes, the upper (lower) standard deviation line reaches a maximum (minimum) and then stabilizes. Both lines also converge as the number of sequential bets increases.

These lines diverge initially because when one has more bets, the randomness accumulates and things become very complicated and intractable.

However, because of the martingale strategy, when one has more bets, one is more likely to win $80 and leave. Therefore, after a sufficiently large number of bets, all agents will win $80 and leave, then the randomness will dissipate and eventually disappear.

That's why the standard deviation lines first explode and eventually flat out.



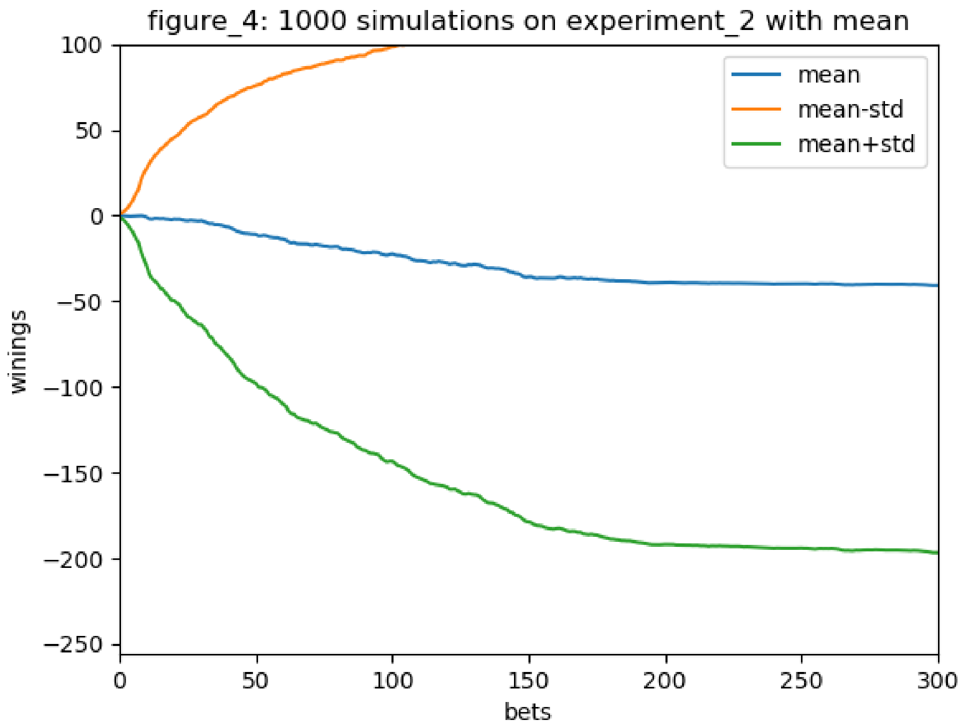
Question 4

Out of my 1000 Monte Carlo simulations, 634 simulations reached a winning of \$80. Therefore, my estimated probability of winning \$80 within 1000 bets is 634/1000 = 0.634.

Question 5

If we take the average winning of all 1000 simulations, we will have \$-42.713. Therefore, by the method of moments, \$-42.713 would be my estimate of the expected value of winnings after 1000 sequential bets.

The visualization also verifies this claim: in Figure 4, the mean flats out near \$-50 at around 300 bets.

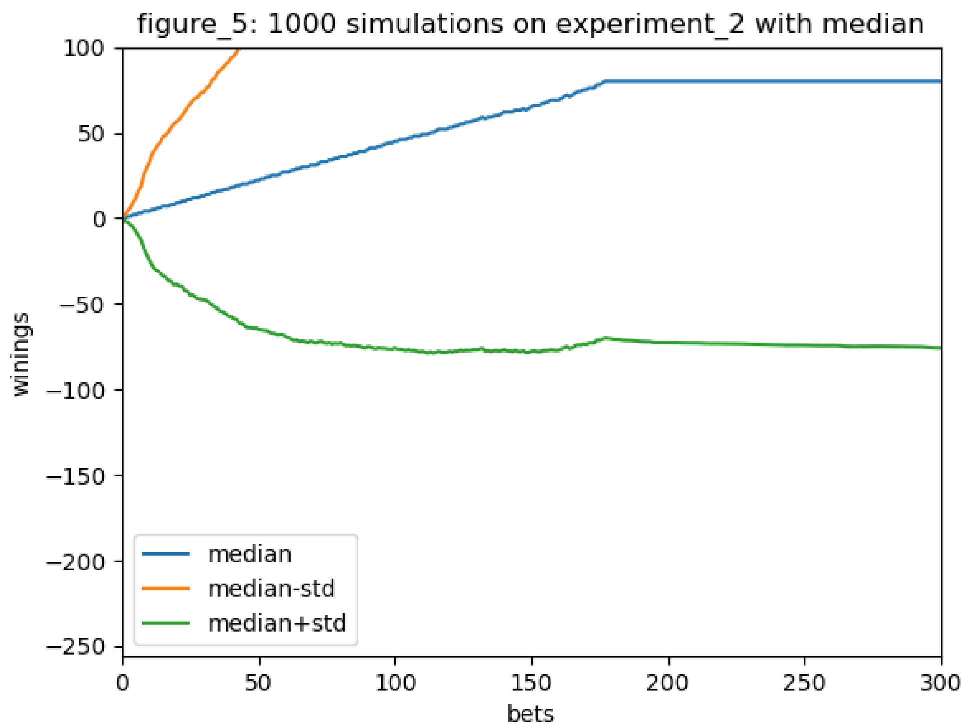


Question 6

Yes, the upper (lower) standard deviation line reaches a maximum (minimum) and then stabilizes. Both lines also converge as the number of sequential bets increases.

The analysis is similar to Question 2.

- Initially, when one has more bets, the randomness accumulates and things become very complicated.
- As more bets are realized, because of the martingale strategy, people can eventually end up with 2 results: either win $80 and leave, or lose $-256 and leave. Therefore, the randomness will decrease over time and eventually flat out.



Question 7

Using the result of one specific random episode may not be representative because it would contain too much noise -- essentially it's a stochastic process and things can become very complicated.

If we use expected values instead, the randomness would be averaged out, so it would be easier and safer to see the overall pattern of the stochastic processes.