Project 1: Martingale Report

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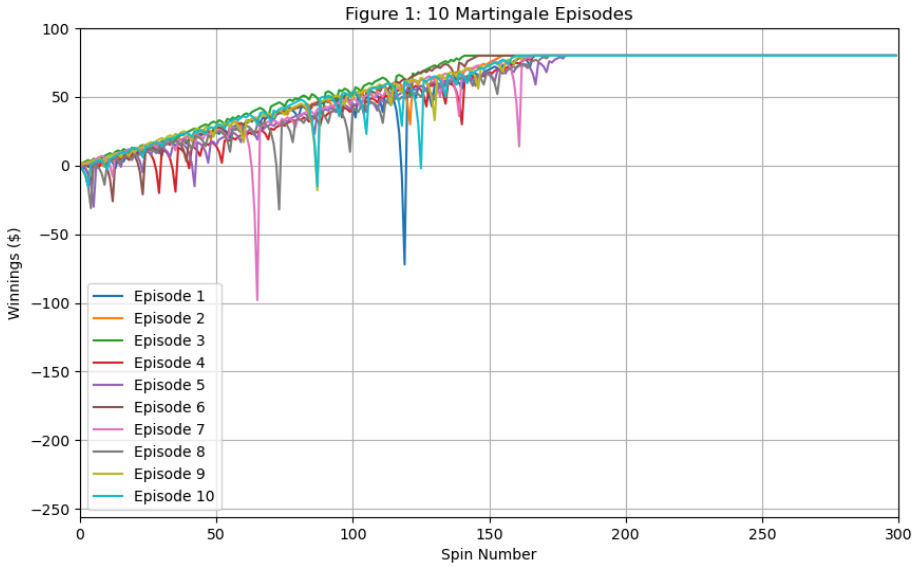
This project simulates the Martingale betting strategy (double after a loss, reset after a win) with Monte Carlo runs. We test two cases: unlimited bankroll and a realistic $256 bankroll to see how often we reach $80.



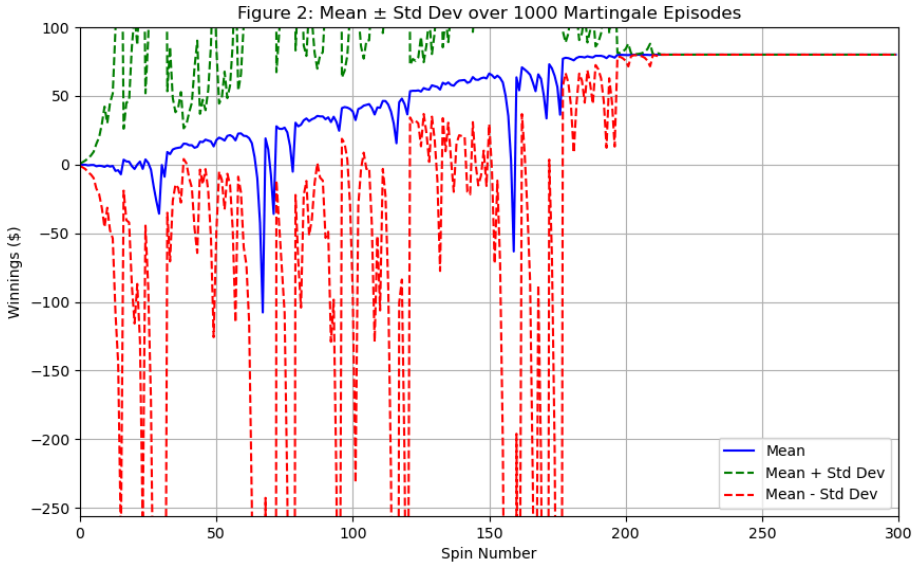
QUESTION 1 : IN EXPERIMENT 1, BASED ON THE EXPERIMENT RESULTS CALCULATE AND PROVIDE THE ESTIMATED PROBABILITY OF WINNING EXACTLY $80 WITHIN 1000 SEQUENTIAL BETS?

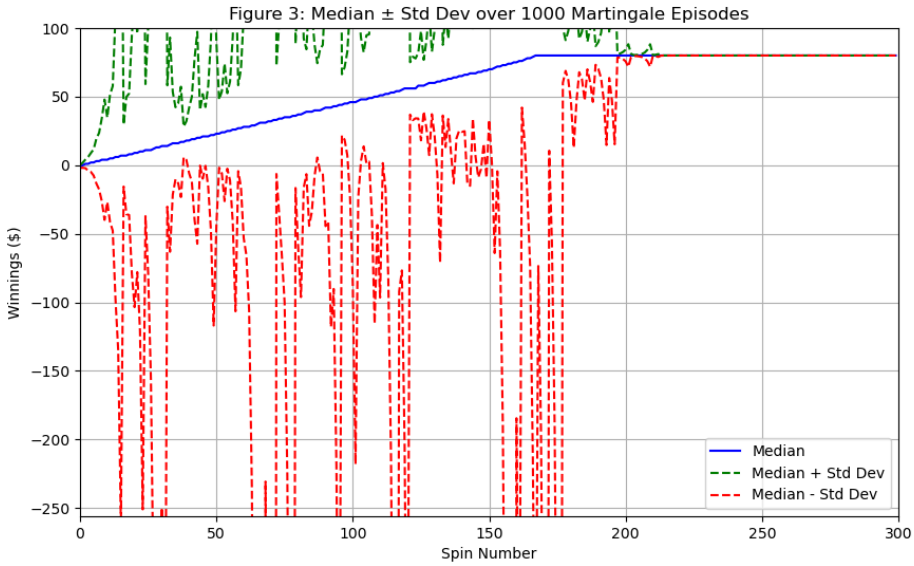
Based on the simulated output of 1000 sequential bets run in experiment 1 the probability of winning exactly $80 is 100%. This is because the martingale strategy that doubles the bet after losing a spin drive the winnings upwards since if the round is a lose eventually another win will happen to increase the winnings by 1. 1000 sequential bets is enough to allow for the strategy to more then likely

make it to the $80 target. There theoretically is a chance that the can lose a lot of rounds and not make it to the target but with 1000 spins that outcome is unlikely.

QUESTION 2 : IN EXPERIMENT 1, WHAT IS THE ESTIMATED EXPECTED VALUE OF WINNINGS AFTER 1000 SEQUENTIAL BETS? THOROUGHLY EXPLAIN YOUR REASONING FOR THE ANSWER.

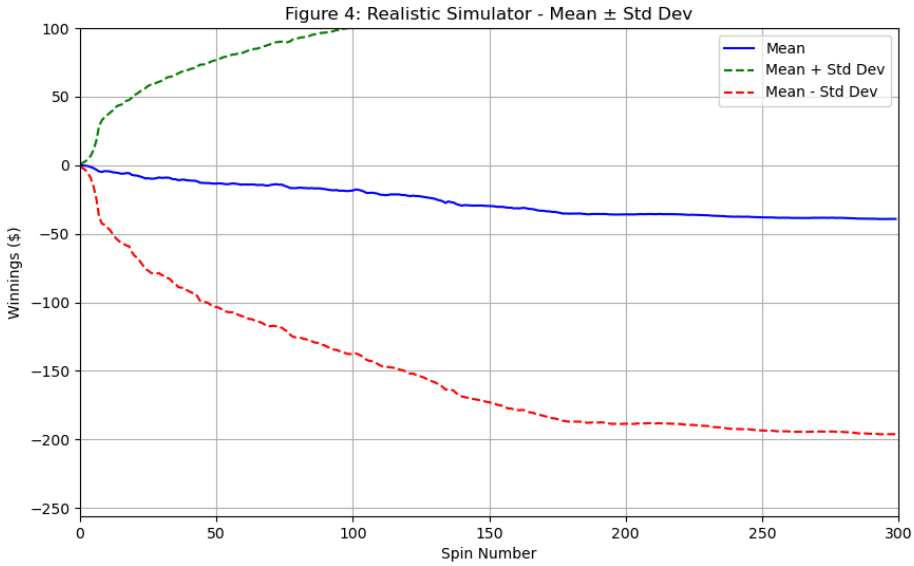
The estimated expected value after 1000 sequential bets would be $80. From out experiment that we ran 1000 sequential bets 1000 of those outcomes came back at $80 and to get the expected value we do 1 * 80 = 80.





QUESTION 3 : IN EXPERIMENT 1, DO THE UPPER STANDARD DEVIATION LINE (MEAN + STDEV) AND LOWER STANDARD DEVIATION LINE (MEAN − STDEV) STABILIZE AT A MAXIMUM (OR MINIMUM) VALUE (I.E., REACH A MAXIMUM (OR MINIMUM) VALUE AND THEN STABILIZE)?

Yes both the upper and lower standard deviation lines reach a max / min at $80. There is a lot of variation because some episodes hit the $80 target quickly and stay flat, while others are still bouncing up and down near zero. This mix makes the spread wide. As more spins happen, fewer episodes are still in play—most have already locked in at $80. With more and more runs stuck at the same value, the average moves closer to $80 and the spread gets smaller, until both the mean and the standard deviation lines flatten at $80.

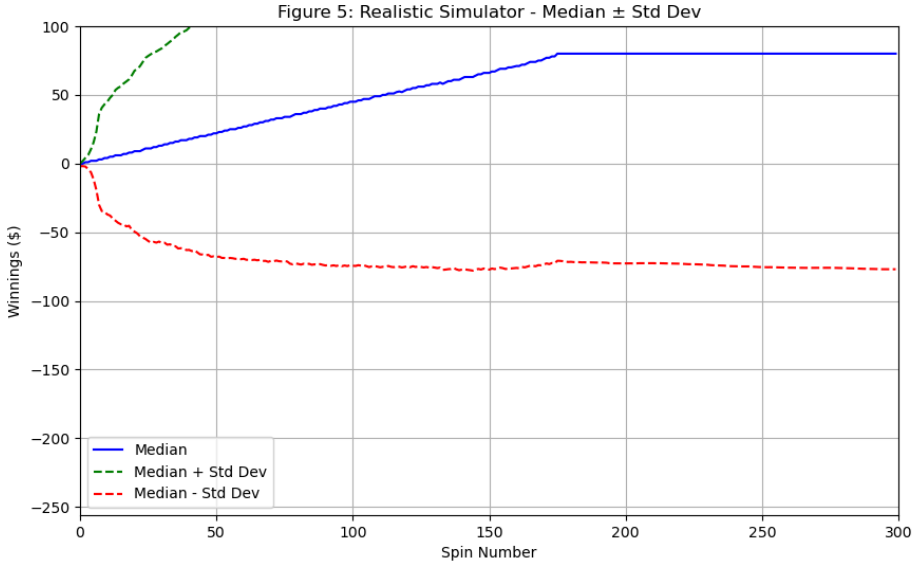


QUESTION 4 : IN EXPERIMENT 2, BASED ON THE EXPERIMENT RESULTS CALCULATE AND PROVIDE THE ESTIMATED PROBABILITY OF WINNING EXACTLY $80 WITHIN 1000 SEQUENTIAL BETS.

Based on the simulated output of 1000 sequential bets run in experiment 2 the probability of winning exactly $80 came in at 63.6%. The difference in the second experiment is the introduction of a bankroll limitation not allowing the player to keep playing after going below -256. The martingale strategy in the first experiment was allowed to keep betting and that allowed the strategy to keep doubling the bet until it recovered the losses. With the introduction of the bankroll, long losing streaks stopped the player from betting not allowing it to recover and hit the target.

Question 5 : In Experiment 2, what is the estimated expected value of winnings after 1000 sequential bets? Thoroughly explain your reasoning for the answer.

Since there are two possible outcomes the player, Potentially if the player ends with a balance less then 80, but that is not probable. The first outcome is reaching 80 and remaining at that balance which has a 63.6% probability of happening. The second outcome in the experiment that happened was reaching -256 which occurred 36.4% of the time. Giving an expected value of playing to be $80 * .6360 + -256 * .364 = -42.304.



Question 6 : In Experiment 2, do the upper standard deviation line (mean + stdev) and lower standard deviation line (mean − stdev) stabilize at a maximum (or minimum) value (i.e., reach a maximum (or minimum) value and then stabilize)?

Yes the upper and lower standard deviation lines will stabilize around 120 and -204 with the mean going to the expected value. In the first experiment there was only one outcome and the lines converged to that expected value. With this experiment having two outcomes the standard deviations do not converge and

instead converge to constant values. If we look at the median graph we can see it goes to $80 as that is the most likely final outcome.

Question 7 : What are some of the benefits of using expected values when conducting experiments instead of simply using the result of one specific random episode?

If we used the result of one specific random episode and it gets to $80 that does not tells us anything about the strategy of how likely it has a profit or how likely it loose. The expected value shows us what would happen if we keep on playing and in this context if the strategy is worth playing.