PROJECT 1: MARTINGALE

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QUESTION 1

In Experiment 1, based off the experiment results calculate the estimated probability of winning $80 within 1000 sequential bets. Explain your reasoning for the answer using the experiment thoroughly (not based on plots).

Response

The probability of winning $80 within 1000 sequential bets should be 1. This conclusion is made based on the experiments performed in this project. In experiment 1, the player reaches to $80 between the 150th to 200th bet ((refer to figure 1). If I perform the same simulations for 1000 times (experiment 1-2), in average the result still reaches to $80 at around 200th bets. This result indicates the scaling of the experiment from 10 times to 1000 times does not alter the outcome. Therefore, the play will always win $80 within the 1000 bets.

QUESTION 2

In Experiment 1, what is the estimated expected value of winnings after 1000 sequential bets? Thoroughly explain your reasoning for the answer.

Response

Based on the response 1 in above, there is a probability of 1 to achieve the value $80 after 1000 sequential bets. Therefore, the expected value of the winning should be: 1 * $80 = $80.

QUESTION 3

In Experiment 1, do the (mean + standard deviation) line and (mean – standard deviation) line reach a maximum value then stabilize? Do the lines converge as the number of sequential bets increases? Explain why it does or does not thoroughly.

Response

As the number of sequential bets increases, both of the (mean + std) line and the (mean – std) line first fluctuate greatly, then stabilize at around 200th bet (refer to Figure 2). This indicates the standard deviation will eventually get stabilized to zero as the number of sequential bets increases. The large fluctuation occurs in the beginning of the simulation due to the unlimited betting money. With this setup, the player is able to lost large dollar amount before the results reaches to $80 in the game. And once the goal is achieved, the betting is over hence leading a stable standard deviation.

QUESTION 4

In Experiment 2, based off the experiment results calculate the estimated probability of winning $80 within 1000 sequential bets. Explain your reasoning for the answer using the experiment thoroughly. (not based on plots).

Response

In experiment 2, I count the number of simulations that reach to $80 at the end in order to calculate the estimated probability. Within the 1000 sequential bets, there are 636 times in total. Hence the probability of winning $80 is: 636/1000 = 63.6%

QUESTION 5

In Experiment 2, what is the estimated expected value of our winnings after 1000 sequential bets? Thoroughly explain your reasoning for the answer (not based on plots).

Response

There is a probability of 63.6% for winning $80 and a probability of 36.4% for losing $256 in 1000 sequential bets. The expected value is calculated as following:

63.6%*80 – 36.4% *256 = -42.98

QUESTION 6

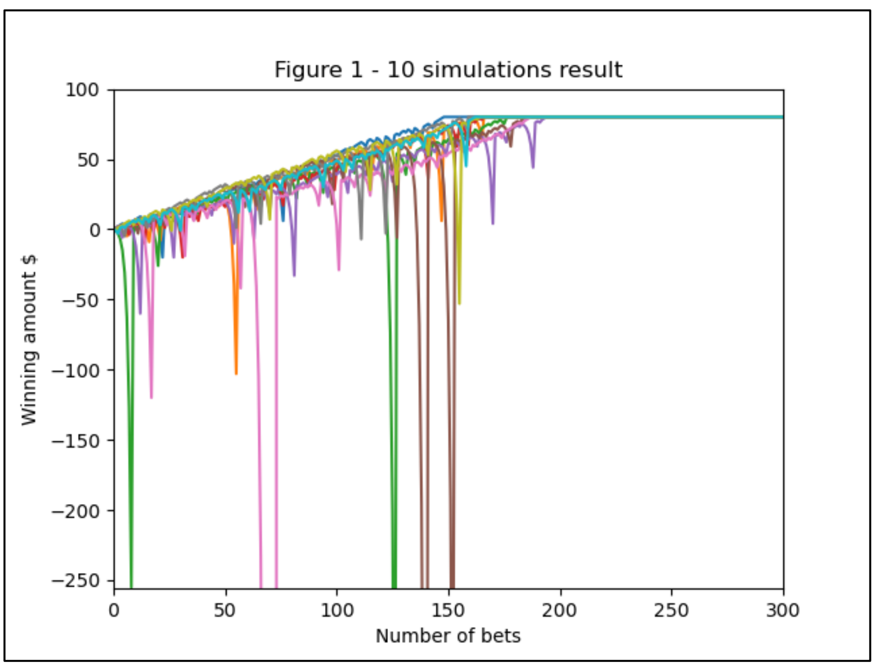
In Experiment 2, do the (mean + standard deviation) line and (mean – standard deviation) line reach a maximum value then stabilize? Do the lines converge as the number of sequential bets increases? Explain why it does or does not thoroughly.

Response

As the number of sequential bets increases, the (mean ± std) lines first increases/decreases, then converges to a constant value (refer to Figure 4). There is a similar trend for the median ± std lines (refer to Figure 5). In both cases, the (mean +std) and (median +std) lines get out of bounds, and the (mean -std) and (median – std) lines clearly illustrate that the standard deviation converges and get parallel to the mean and the median plots respectively. Therefore, I believe the standard deviation reaches a maximum value and then converges when the $ amount of winning exceed over $80.

This happens due to the new constraint on limiting the available money spent on the game, which curbs the fluctuating behavior. With this setup, the player either results to win $80 or lose $256. The betting is over whichever the outcome achieves first and gets carried forward respectively.

GRAPH



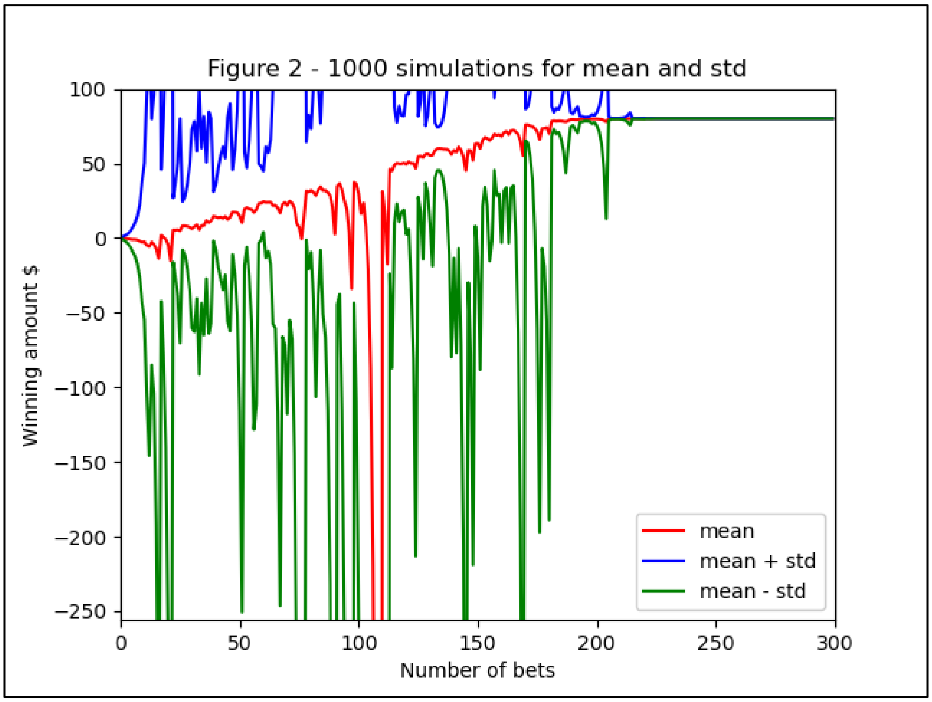


Figure 2 - 1000 simulations for mean and std
Winning amount $
Number of bets
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300
mean
mean + std
mean - std

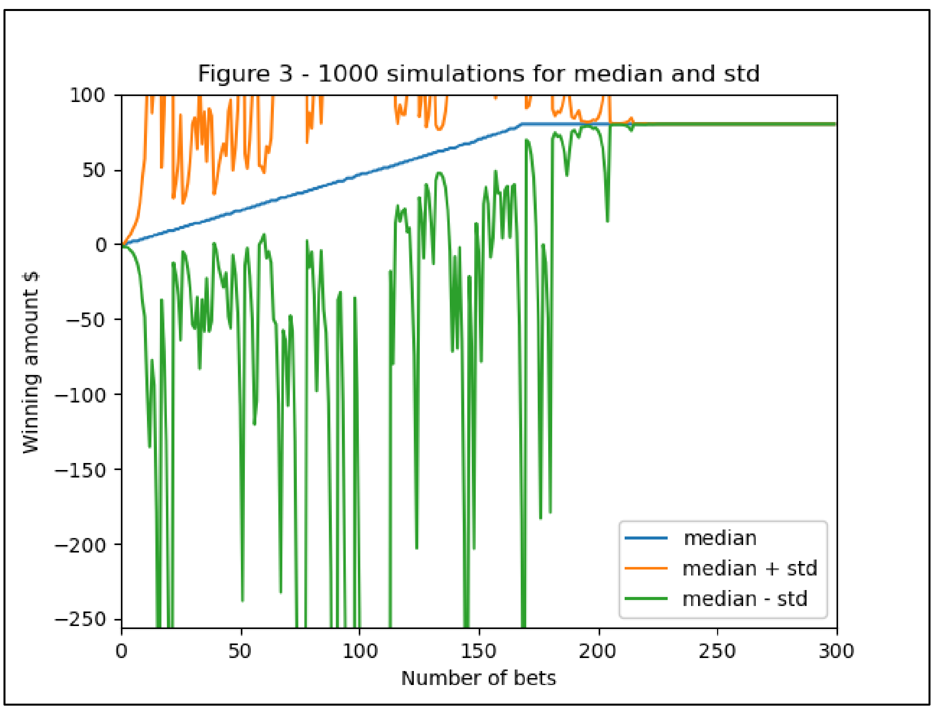


Figure 3 - 1000 simulations for median and std
Winning amount $
Number of bets
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300
median
median + std
median - std

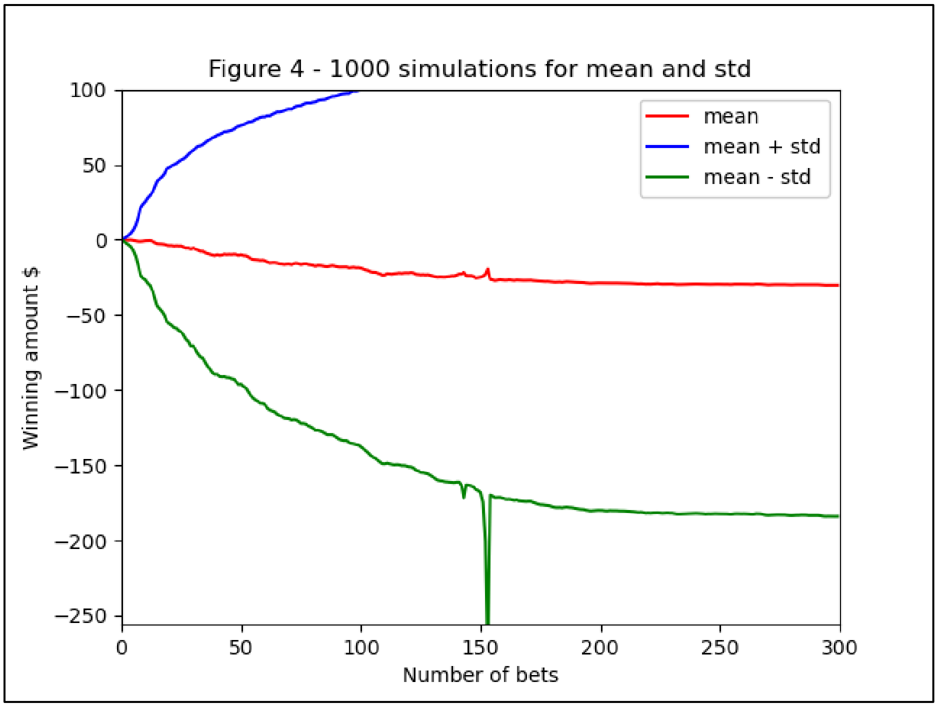


Figure 4 - 1000 simulations for mean and std
mean
mean + std
mean - std
Winning amount $
Number of bets
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300

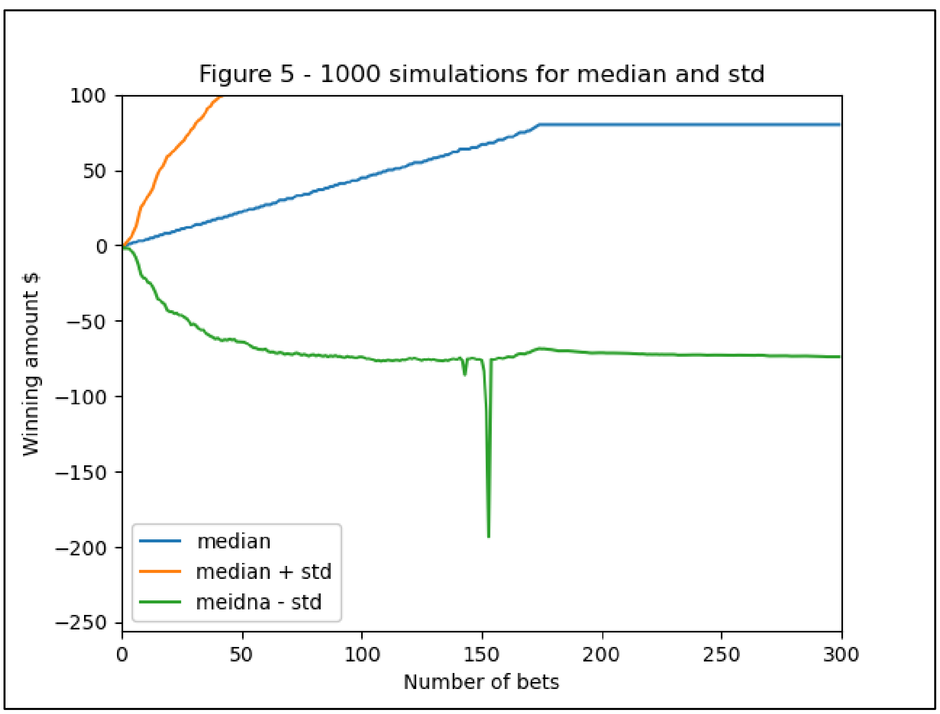


Figure 5 - 1000 simulations for median and std
median
median + std
meidna - std
Winning amount $
Number of bets
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300