CS 7646 ML4T
Project 1: Martingale

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1 EXPERIMENT 1:

1.1 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).

Answer: Base on my experiment results, the probability of winning $80 with in 1000 sequential bets is 100%. In Experiment 1, 1000 of 1000 times of the results reach the target $80 winning and stop betting before reaching 1000 bets.

1.2 Question 2:

In Experiment 1, what is the estimated expected value of winnings after 1000 sequential bets? Thoroughly explain your reasoning for the answer. See the following Wikipedia entry to learn about expected value: Wikipedia: Expected value

Answer: In Experiment 1, the probability of winning $80 is $P(\$80) = 100\%$, and the value of winning is $V(\$80) = \$80$ in each run. Thus the expected value of winnings after 1000 sequential bets is $E_{winning} = P(\$80) \times V(\$80) = \$80$.

1.3 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.

Hint: If it does not converge and/or stabilize, explain why it does not. If it does converge and/or stabilize, also discuss the value(s) at which it does so.

Answer: No, the (mean ± standard deviation) lines do not stabilize and converge as the number of bets increases. In each bet, if it's not win, the bet amount will double. When the number of bets increases, the possibility of losing a larger amount of money will increase because of the unlimited bank roll.

2 EXPERIMENT 2:

2.1 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).

Answer: Base on the 1000 simulation results, the 647 of 1000 times run reach \$80 winning target before 1000 bets, and 353 of 1000 times run reach \$256 bank roll before 1000 bets. The probability of winning \$80 within 1000 bets is $P(\$80) = 64.7\%$ in Experiment 2.

2.2 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).

Answer: The probability of winning \$80 is $P(\$80) = 64.7\%$, and winning \$-256 is $P(\$-256) = 35.3\%$. The expected value of our winnings after 1000 sequential bets is $E_{winning} = P(\$80) \times V(\$80) + P(\$-256) \times V(\$-256) = \$-38.608$

2.3 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.

Hint: If it does not converge and/or stabilize, explain why it does not. If it does converge and/or stabilize, also discuss the value(s) at which it does so.

Answer: Yes, the (mean $\pm$ standard deviation) lines reach maximum values and then stabilize. The lines converge as the number of sequential bets increases. The winning target and the bank roll limits the maximum win and lose in each game. In 1000 times bets, the winning amount will reach either \$80 or \$-256, and the probability of reach these two results will converge as the sequential bets increases according to the law of large numbers. As a result, the mean value and standard deviation stabilize and converge.

3 CHARTS:

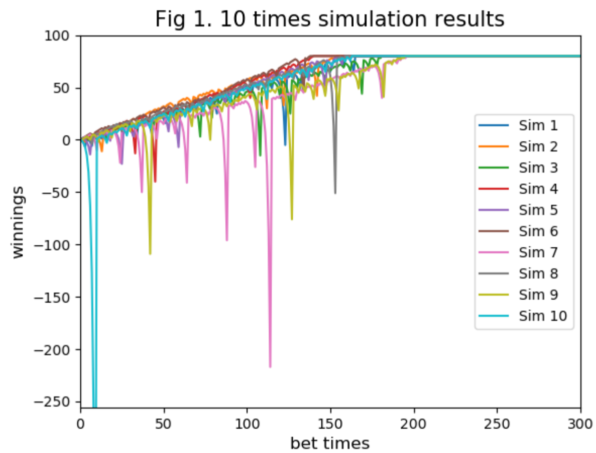

Figure 1—Winnings of 10 simple runs of the simulation.

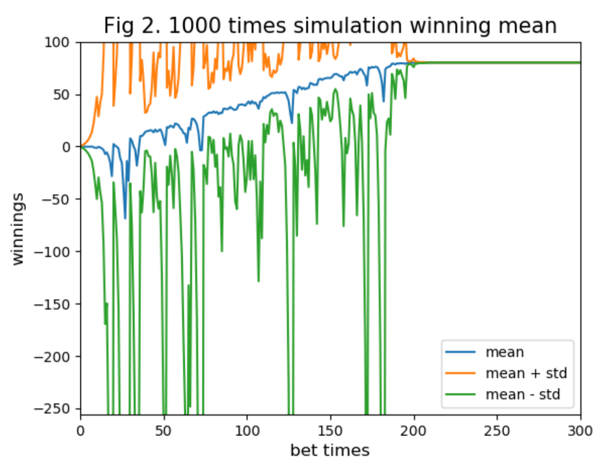

Figure 2—Statistical results 1 of the winning values of 1000 simulations. The blue curve is the mean value of the 1000 runs in each bet, the orange curve is the mean value (+) the standard deviation, and the green curve is the mean (-) standard deviation.

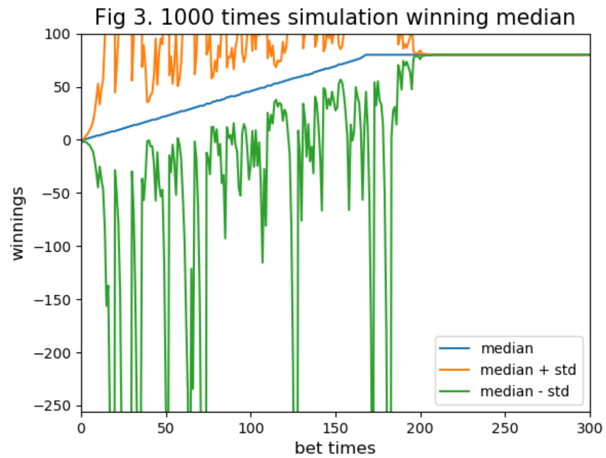

Figure 3—Statistical results 2 of the winning values of 1000 simulations. The blue curve is the median value of the 1000 runs in each bet, the orange curve is the median value (+) the standard deviation, and the green curve is the median (-) standard deviation at each point.

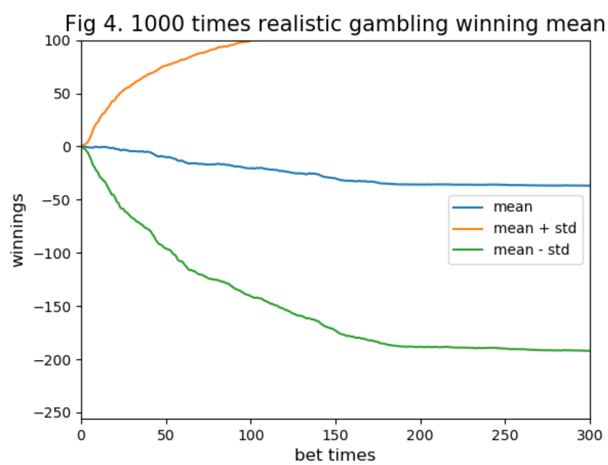

Figure 4—Statistical results 1 of the winning values of 1000 realistic gambling simulations. The blue curve is the mean value of the 1000 runs in each bet, the orange curve is the mean value (+) the standard deviation, and the green curve is the mean (-) standard deviation at each point.

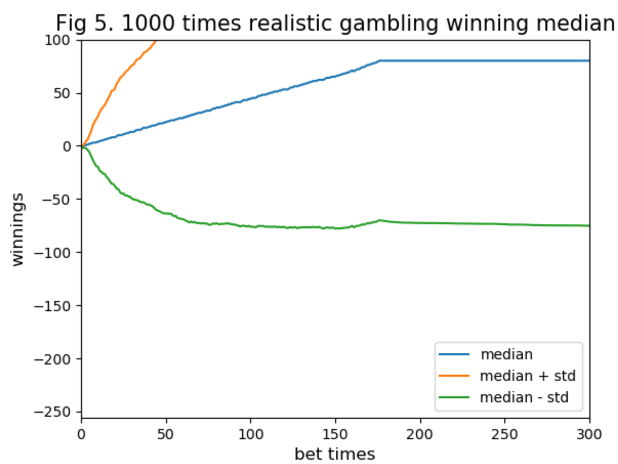

Figure 5—Statistical results 2 of the winning values of 1000 realistic gambling simulations. The blue curve is the median value of the 1000 runs in each bet, the orange curve is the median value (+) the standard deviation, and the green curve is the median (-) standard deviation at each point.