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Report 1:
CS7646: ML4T: Spring 2019
Jan 20, 2019

Question 1: In Experiment 1, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning.

Answer: The probability is very close to 100%. There are three evidence to support this conclusion: 1) I run the simulator 10 times and all the episode ends far before it reached the limitation of 1000 spins with a $80 win (Figure 1). 2) in the Monte Carlo simulation of 1000 times of running the simulator with a 1000 spin limit, both the mean (Figure 2) and median of the episode winnings converged at $80 long before the simulation reached the limit of the spin. The player who follows the strategy in the simple simulator is expected to win $80 before 200 spins, given there is no bank roll limit. 3) in the Monte Carlo simulation, all the 1000 simulation I run ended up with the player wins $80.

Question 2: In Experiment 1, what is the estimated expected value of our winnings after 1000 sequential bets? Explain your reasoning. Go here to learn about expected value: https://en.wikipedia.org/wiki/Expected_value

Answer: The simulation result (Figure 2) indicates that the sample mean converges to $80 long before it reaches 1000 times of spin, so the expected value is $80.

Figure 1: Winnings of the strategy
(simple version)

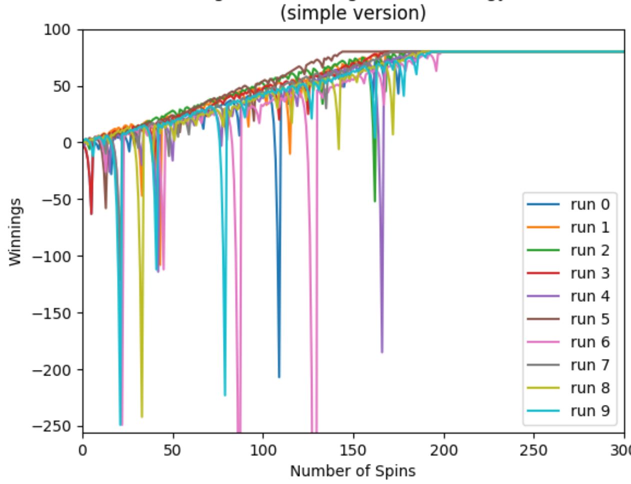


Figure 2: Mean Winnings of 1000 episodes
(simple version)

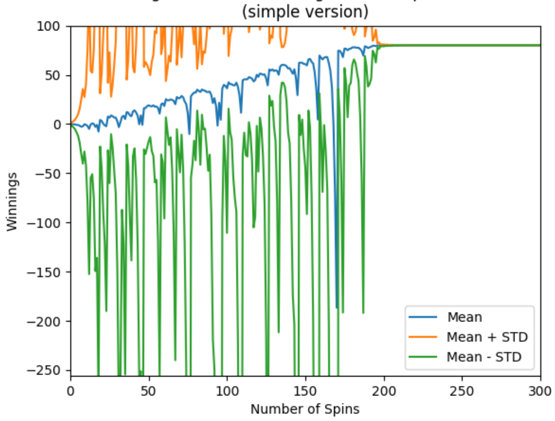
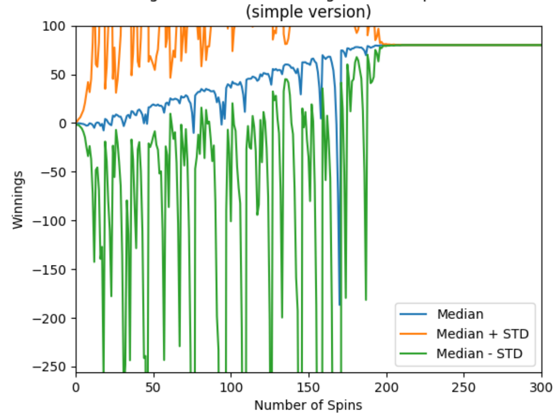


Figure 3: Median Winnings of 1000 episodes
(simple version)



Question 3: In Experiment 1, does the standard deviation reach a maximum value then stabilize as the number of sequential bets increases? Explain why it does (or does not).

Answer: The standard deviation is very volatile for about the first 200 spins and then eventually become zero (Figure 2 and Figures). standard deviation is very volatile because the probability of winning or lose if very unpredictable for each spin. The standard deviation finally converges at 0 because simple simulator will eventually win given enough spins (the number of spins needed for winning is a finite number which is smaller than 1000 according to the simulation.)

Since the simulator always wins $80, so that the standard deviation of the winning will be zero after the player wins.

Question 4: In Experiment 2, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning.

Answer: in my simulation, out of 1000 repetitions, the simulator won 658 times. The winning rate is 65.8%.

Question 5: In Experiment 2, what is the estimated expected value of our winnings after 1000 sequential bets? Explain your reasoning.

The expected mean of the winnings is $-34. the estimated expected value of our is the mean of the winnings which converges to -$34 according to my simulation.

Question 6: In Experiment 2, does the standard deviation reach a maximum value then stabilize as the number of sequential bets increases? Explain why it does (or does not).

Answer: similar to the result of experiment 1, the standard deviation is volatile before the mean and median converges. Then it became stable for the rest of the spins. But standard deviations did not converge to 0, but to a value of 159 in my simulation. The reason is that with the bank roll limited to 256, the simulator is not guaranteed to win the game given 1000 spins per episode.

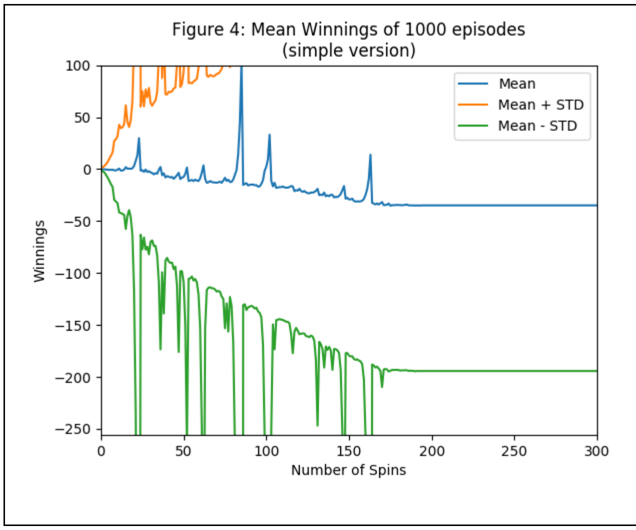


Figure 4: Mean Winnings of 1000 episodes
(simple version)
Mean
Mean + STD
Mean - STD
Winnings
Number of Spins

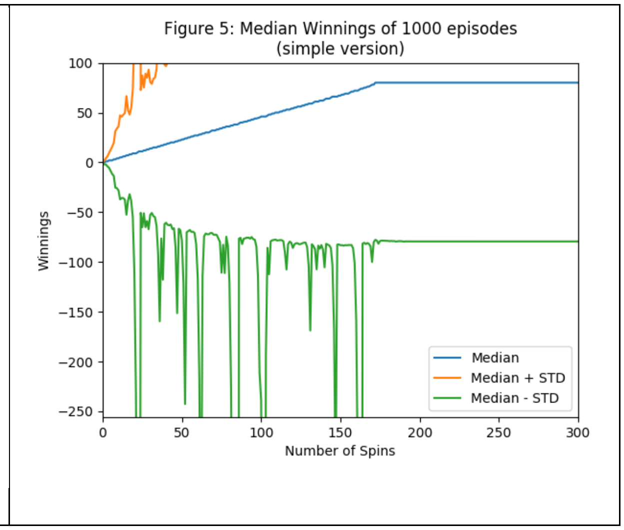


Figure 5: Median Winnings of 1000 episodes
(simple version)
Median
Median + STD
Median - STD
Winnings
Number of Spins