Project 1

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Question 1: In Experiment 1, based on the experiment results calculate and provide the estimated probability of winning $80 within 1000 sequential bets. Thoroughly explain your reasoning for the answer using the experiment output. Your explanation should NOT be based on estimates from visually inspecting your plots, but from analyzing any output from your simulation.

My estimation of probability of wining $80 within 1000 sequential bets is 1 in Experiment 1. It is calculated by the formula: P(wins) = total number of wins/total number of simulations. By plugging in the results from my simulation, I got probability of win = 1000/1000 = 1.

Question 2: In Experiment 1, what is the estimated expected value of winnings after 1000 sequential bets? Thoroughly explain your reasoning for the answer.

An expectation can be thought of as an arithmetic mean and can be calculated as: $E[X] = \sum_x P[X = x]$. The expected value of winnings within 1000 sequential bets can be viewed as the arithmetic mean of 1000 simulations. By take the average of wining of 1000 simulations, I got a number 80. As the player would stop playing the game when she wins. Then the value of winnings would not change after 1000 simulations. Therefore, the estimated expected value of winnings after 1000 sequential bets is $80.

Question 3: In Experiment 1, do the upper standard deviation line (mean + stdev) and lower standard deviation line (mean – stdev) reach a maximum (or minimum) value and then stabilize? Do the standard deviation lines converge as the number of sequential bets increases? Thoroughly explain why it does or does not.

From numerical results and Figure 2, the upper standard deviation line and lower standard deviation line reach a maximum value and then stabilize. As the number of bets increases, the standard deviation lines converge. The reason is that as the player reach $80, he would stop playing, and the standard deviation would become 0. Then the mean +/- standard deviation would converge to mean.

Question 4: In Experiment 2, based on the experiment results calculate and provide the estimated probability of winning $80 within 1000 sequential bets. Thoroughly explain your reasoning for the answer using the experiment output. Your explanation should NOT be based on estimates from visually inspecting your plots, but from analyzing any output from your simulation.

The experiment data varies at each simulations. In order to calculate the estimated probability of winning $80 within 1000 bets, we need to focus the last position of each simulation. By calculate the number wining $80 at the end of spin for each simulation, the number of wining $80 within 1000 sequential bets from 1000 simulations is 640. Therefore, the estimated probability of winning $80 within 1000 sequential is 640/1000 = 0.64.

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

By count the number of winning being $80 and $ -256 and do the calculation of estimated expectation, we can get the estimated expected value winnings for 1000 sequential bets. As we use current data to predict the future, the expected value after 1000 sequential bets can be calculated as (360/1000) * (-256) + (640/1000) * 80 = -40.96

Question 6: In Experiment 2, do the upper standard deviation line (mean + stdev) and lower standard deviation line (mean – stdev) reach a maximum (or minimum) value and then stabilize? Do the standard deviation lines converge as the number of sequential bets increases? Thoroughly explain why it does or does not.

From the graph, the upper standard deviation line and lower standard deviation line do not stabilize. As we do not see the constant probability of winning at end of spin in the experiment 2. We would not have stable winning as number of sequential bets increases, then the standard deviation lines would not be 0 and the standard deviation lines would not converge eventually.

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?

Data has randomness, when use single experiment to get result, we should simulate numerous experiments to encounter as much randomness as possible to get the real operating characteristics. By calculated the expected values (mean performances), we can have a more comprehensive result. However, if we only use one specific episode, the data is only generated from one specific scenario, it is not comprehensive enough. We can think about this as central limit theorem that when we take sufficiently large sample, the sample mean will converge to its true mean.

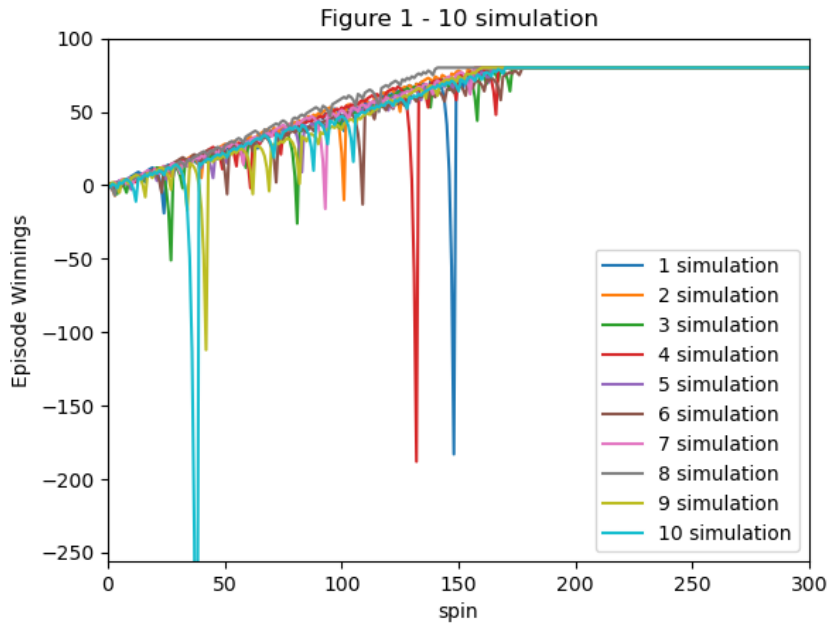
Figure 1 - 10 simulation
Episode Winnings
spin
1 simulation
2 simulation
3 simulation
4 simulation
5 simulation
6 simulation
7 simulation
8 simulation
9 simulation
10 simulation

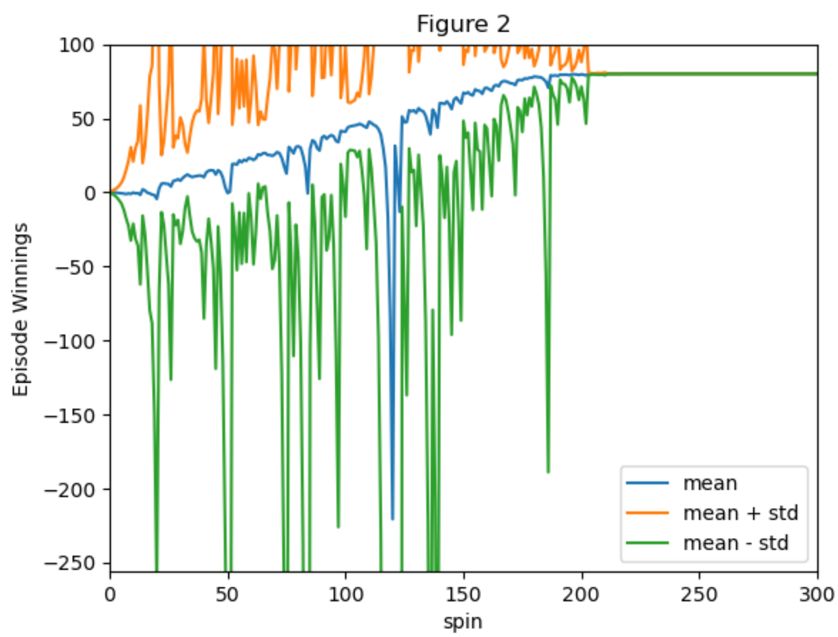
Figure 2
Episode Winnings
spin
mean
mean + std
mean - std

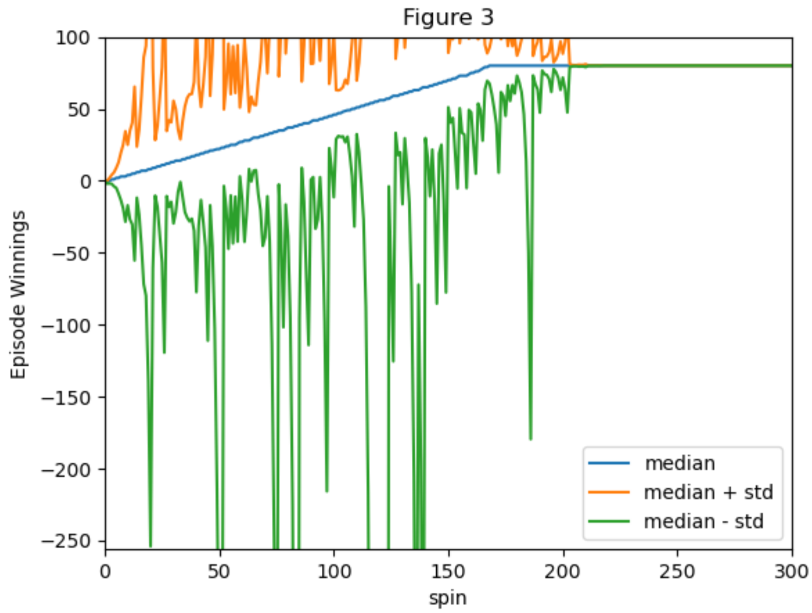
Figure 3
Episode Winnings
spin
median
median + std
median - std

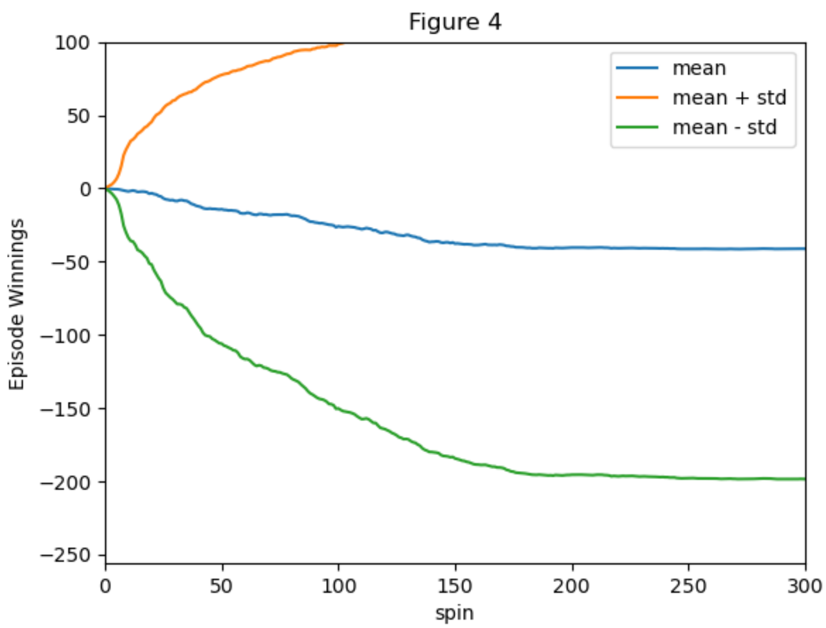
Figure 4
Episode Winnings
spin
mean
mean + std
mean - std

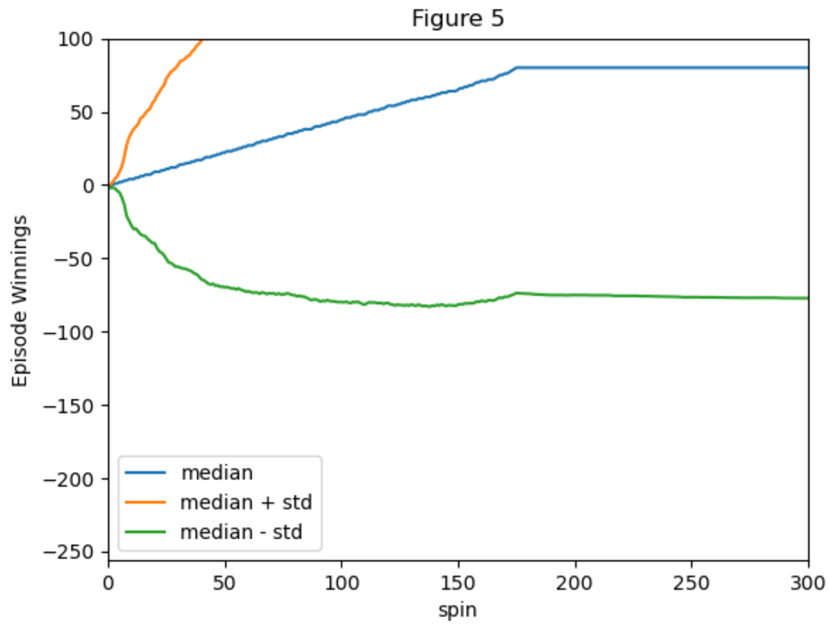
Figure 5
Episode Winnings
spin
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300
median
median + std
median - std