Report: Project 1 - Martingale

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Abstract—This report contains the answers to the Evaluation Questions for Project 1 – Martingale. The project sought to analyze two betting strategies for roulette with specific focus on their profitability in the long run.

1 QUESTION SET

1.1 Question Set 1 - Part 1

The experimental results of the simulation showed that $80 was achieved in 100% of the simulations of the episodes, indicating that the estimated proportion representing the likelihood of profiting exactly $80 in an episode is 1.

1.2 Question Set 1 - Part 2

Out of the 10 simulations of episodes, not a single episode settled on a value other than $80, even though some of the accumulated winnings within the first 300 spins varied by large amounts. However, with unlimited bankroll and a target of only $80, the spinner only would need a handful of large-value spins to go their way in a row to reach the desired target, meaning it makes sense that 100% of simulations settle on $80.

1.3 Question 2

In Experiment One, the estimated value of 1000 sequential bets is $80. Every single episode settled on $80 of winnings after ~350 spins, followed by betting being paused because the target winnings had been reached. As mentioned previously, with unlimited bankroll and a target of only $80, the strategy ensures that, on average, 1000 spins should settle on the target amount.

1.4 Question Set 3 - Part 1

In Experiment One, the standard deviation lines DO NOT stabilize at all (see Figure 3) within the first 300 spins. After ~350 spins, the standard deviations DO stabilize at 0, because all simulations reach $80 of winnings.

1.5 Question Set 3 - Part 2

As mentioned above, the standard deviation lines converge with one another, both reaching a value of 0 around 350 spins. This happens because the accumulated winnings reach $80 for every single simulation and bets are paused, meaning there is no standard deviation for the mean or median winnings.

1.6 Question 4

Based on the 1000 simulations, 585 achieved $80 of winnings after an episode of spins, while 415 did not. This means that the estimated probability of reaching $80 of winnings using this strategy is 58.5%.

1.7 Question 5

After 1000 simulations of 1000 spins, the expected value of winnings after spin 1000 is -$52.70, indicating that, on average, players employing this strategy should expect to *lose* money.

1.8 Question Set 6 - Part 1

The standard deviation lines do stabilize, but only after around 400 spins, and they stabilize at a value of $140. The standard deviation initially increases, before slightly decreasing until around spin 400, when it seems to stabilize, as does the median.

1.9 Question Set 6 - Part 2

The standard deviation lines DO NOT converge with each other, even after 1000 spins. This is likely because the strategy likely ensures that bettors, after many spins, settle on either +$80 or -$256, meaning that the standard deviation is still quite large, although the individual values of winnings are consistently one of two options.

1.10 Question 7

Expected values help to remove some of the noise seen in individual episodes, especially in the world of probabilities and variance. Additionally, using expected values allows us to make generalizations about the probabilistic environment we are dealing with, in this case the gambling strategies, and whether or not they are good at producing profit on average.
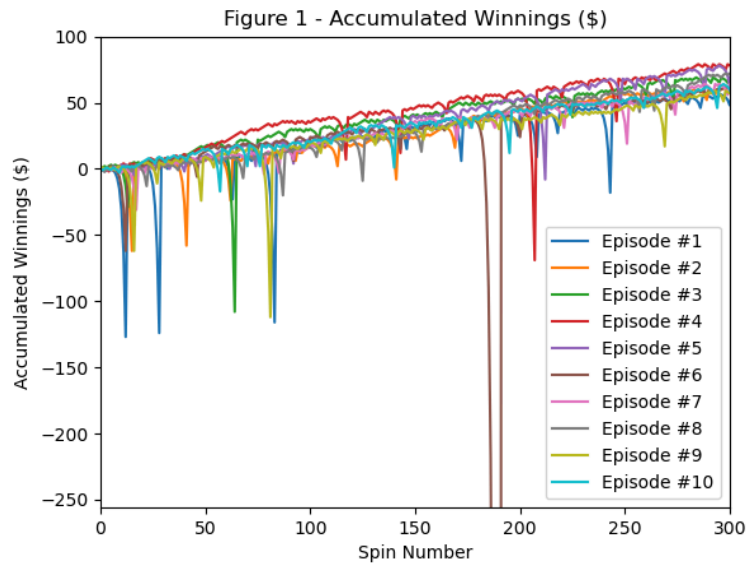
2 FIGURES

2.1 Figure 1

Figure 1—Accumulated Winnings ($) from Spins 0 to 300 for 10 Episodes

2.2 Figure 2
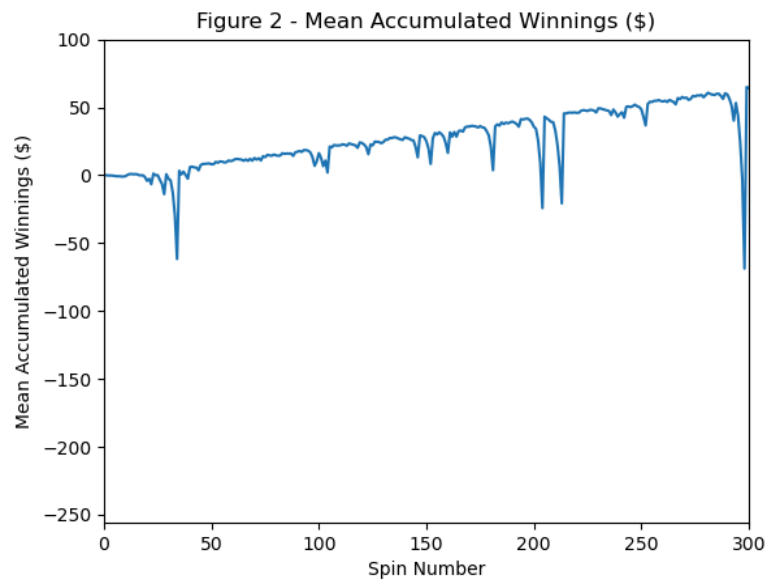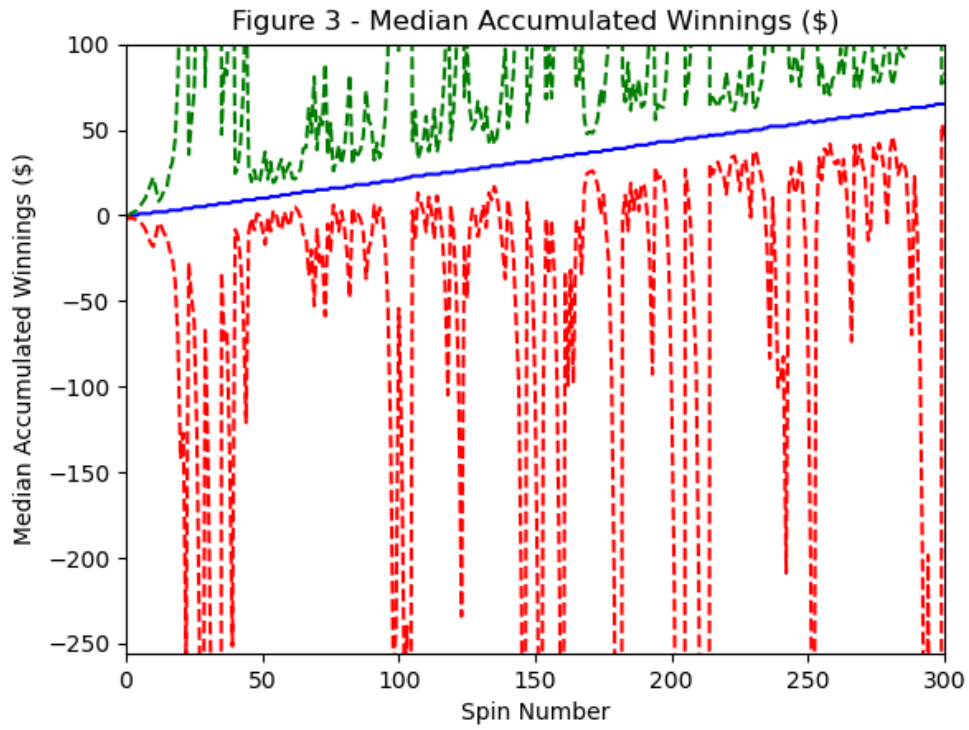
2.3 Figure 3

Figure 3—Median Accumulated Winnings ($) from Spins 0 to 300
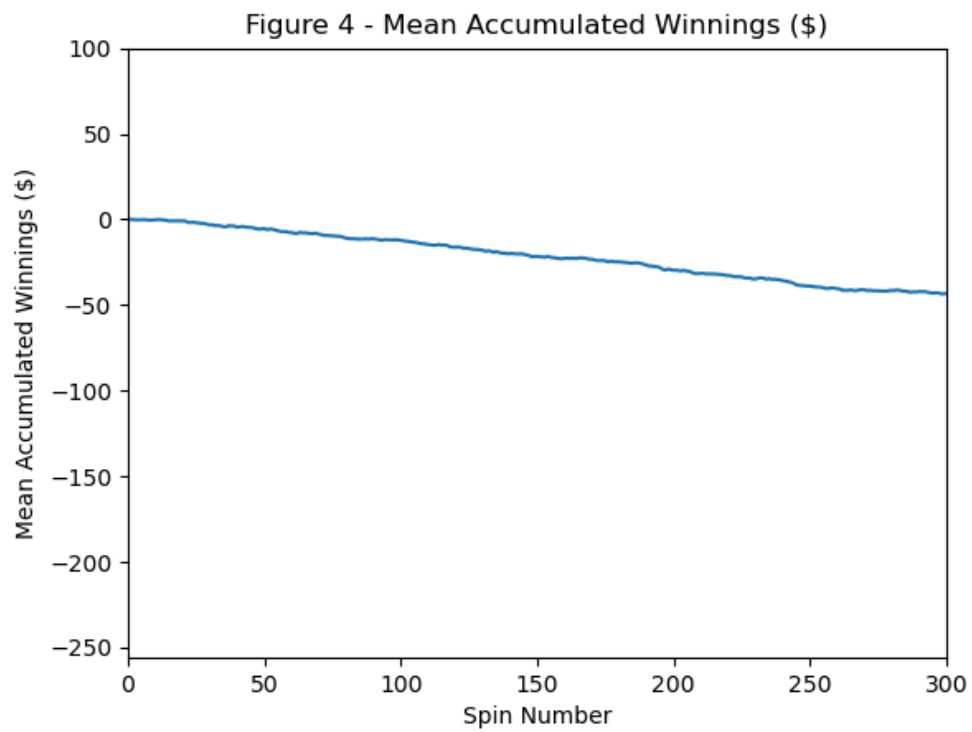for 1000 Episodes

2.3 Figure 4

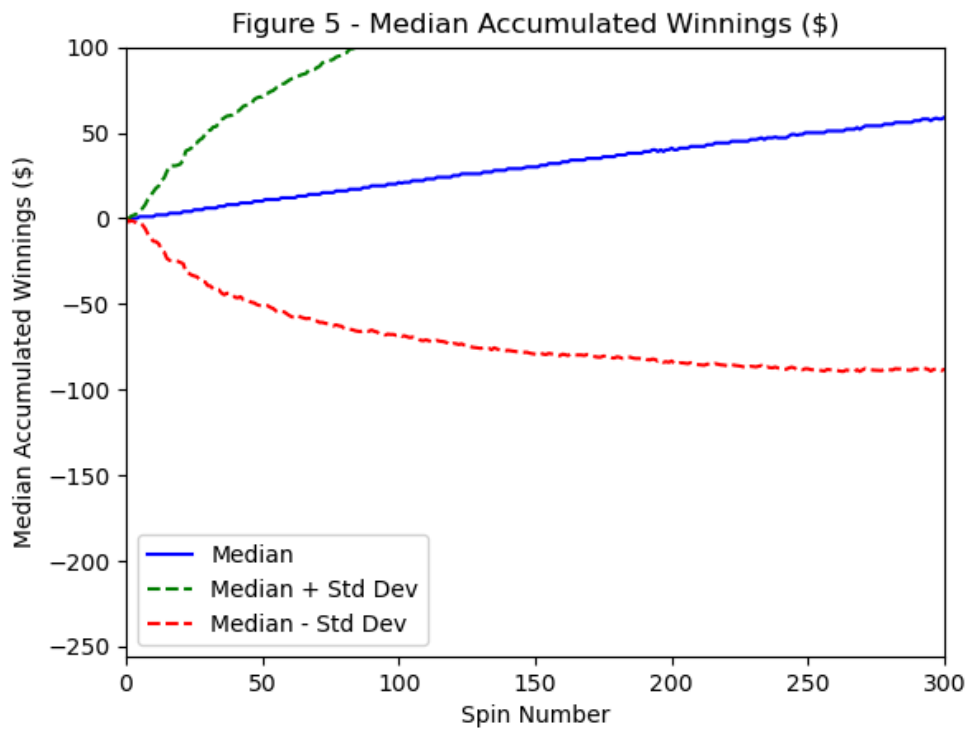*Figure 4*—Mean Accumulated Winnings ($) from Spins 0 to 300 for 1000 Episodes

Figure 5—Median Accumulated Winnings ($) from Spins 0 to 300
for 1000 Episodes