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Blackjack

MOTIVATION

Our motivations for studying the Blackjack problem are focused on gaining a better understanding of the correct approach to the game, finding some effective policies, and most importantly making money. By studying this classic card game using the Monte Carlo method we hope to produce valuable results.

CONTRIBUTIONS

All group members (Carlos Mercado, Edgar Renteria, Maria Guimaraes, Jordan Nicholls) contributed to research and the implementation of the simulation of this problem.

PROBLEM STATEMENT

Blackjack is played with a standard deck of 52 cards, and the goal is to beat the dealer by having a hand that is worth more points than the dealer's hand, without going over 21. Aces can be worth either 1 or 11 points, face cards are worth 10 points, and all other cards are worth their face value. The game begins with each player and the dealer receiving two cards. Players can then choose to "hit" and receive additional cards or "stand" and keep their current hand. The dealer must hit until their hand is worth at least 17 points. If a player's hand exceeds 21 points, they lose automatically, and if the dealer's hand exceeds 21 points, the player wins. Blackjack, or a hand worth exactly 21 points, at worst draws. As part of the problem we were tasked to analyze 5 different policies when playing the games, and understand how/if those probabilities change if we play with an infinite deck or a single deck. The policies previously mentioned.

Policy 1: if your hand ≥ 17, stick. Else hit.

Policy 2: if your hand ≥ 17 and is hard, stick. Else hit unless your hand = 21.

Policy 3: Always stick

Policy 4: Hand < 21, Hit

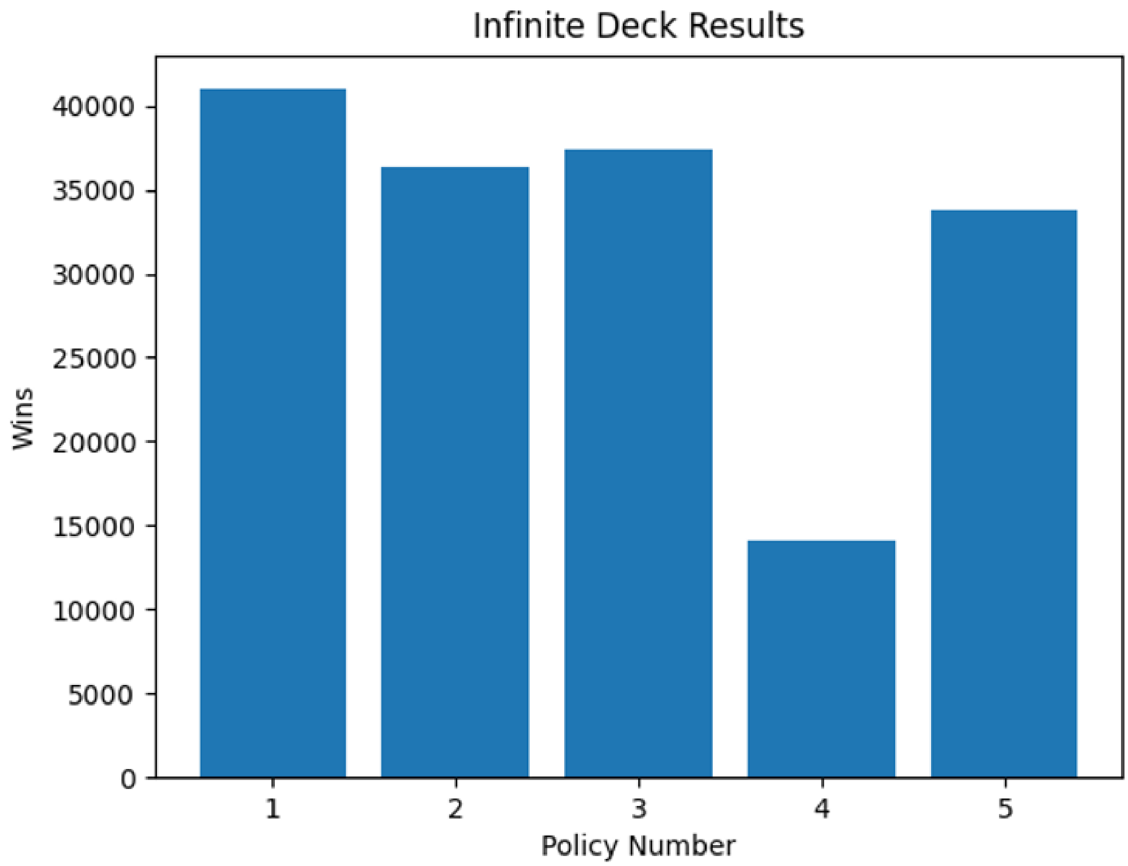
Policy 5: Hit until face card.

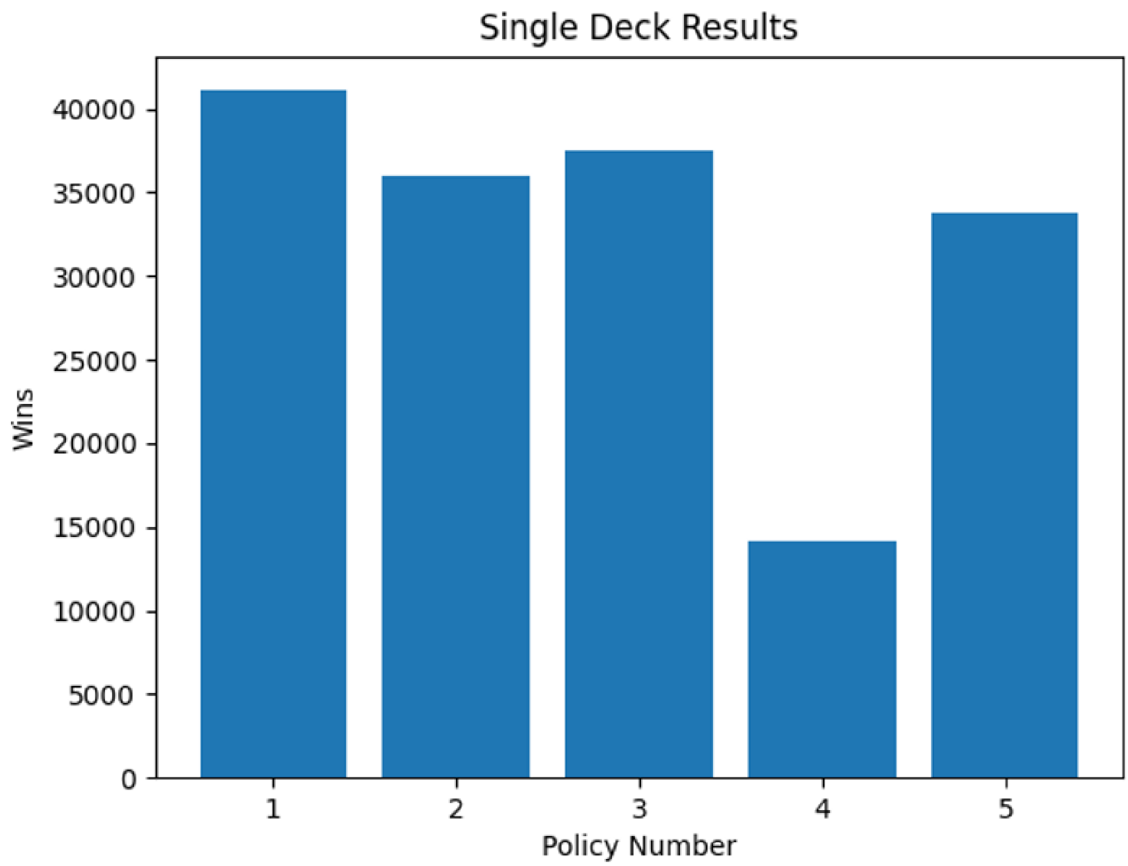
APPROACH

The team's approach to simulating this problem starts by first giving the dealer two cards, and then giving the player two cards. Then add up both dealer and player cards, check for blackjack. For given policy, add cards, or stay. After staying, append cards to the dealer hand until their hand sums to 17 or greater. If the dealer is over 21. Bust, dealer loses. Winner is the person who has the greatest sum of cards at this point. We repeat this for multiple iterations to get a good representation of the underlying probabilities.

RESULTS AND DISCUSSION

For obvious reasons policy 4 performs the worst and by a significant margin in the single deck case while the best performing policy is policy 1 in the single deck case. This is also true for the infinite deck case, in fact the results of the single deck case and infinite deck case are almost identical.


Infinite Deck Results
Wins
40000
35000
30000
25000
20000
15000
10000
5000
0
1
2
3
4
5
Policy Number



IMPROVEMENTS

An improvement that we would make on the project if we were doing it all over again, is to add more complicated policies. Policies that need more than a couple of conditionals would be interesting to study. We could also test a case where the player keeps track of the cards that have been used so far as part of game on a finite deck, and see what those results are. We could also include not only the win rate of games, but also the estimated return.

CONCLUSION

In summary, the team's study of the Blackjack problem using the Monte Carlo method has yielded valuable insights into the game and its various policies. The study has shown that Policy 1 performs the best in both single and infinite deck cases, while Policy 4 performs the worst. The team's approach to simulating the game has provided practical applications in game theory, statistics, and decision-making. Overall, the study has expanded the team's understanding of probability and its relevance in real-world scenarios. The findings of this study can serve as a useful guide for players who wish to maximize their winnings while playing Blackjack.