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Monte Carlo Simulations Documentation

The Monte Carlo simulation program includes two different simulations. The programs are using the pokemon theme. There is a deck of 60 and the player hand has seven cards. The types of cards are trainer, pokemon, and energy.

The first monte carlo simulation wants to find the probability of having AT LEAST one pokemon in your hand when drawing the card. The program tests the probability of having the pokemon in your hand on the first draw when there is 1 pokemon in the deck all the way up to 60(deck size). The program tests this case 1,000,000 times for each amount of pokemon in the deck. This is to get the most accurate results. There is an included excel spreadsheet of a graph and table of results.

```
Number of Pokemon in deck 1 Percentage of True: 11.6753%
Number of Pokemon in deck 2 Percentage of True: 22.1768%
Number of Pokemon in deck 3 Percentage of True: 31.5161%
Number of Pokemon in deck 4 Percentage of True: 39.9226%
Number of Pokemon in deck 5 Percentage of True: 47.4933%
Number of Pokemon in deck 6 Percentage of True: 54.126%
Number of Pokemon in deck 7 Percentage of True: 60.1131%
Number of Pokemon in deck 8 Percentage of True: 65.3516%
Number of Pokemon in deck 9 Percentage of True: 70.0841%
Number of Pokemon in deck 10 Percentage of True: 74.1006%
Number of Pokemon in deck 11 Percentage of True: 77.7625%
Number of Pokemon in deck 12 Percentage of True: 80.9218%
Number of Pokemon in deck 13 Percentage of True: 83.6941%
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Number of Pokemon in deck 47 Percentage of True: 99.9999%
Number of Pokemon in deck 48 Percentage of True: 99.9998%
Number of Pokemon in deck 49 Percentage of True: 100.0%
Number of Pokemon in deck 50 Percentage of True: 100.0%
Number of Pokemon in deck 51 Percentage of True: 100.0%
Number of Pokemon in deck 52 Percentage of True: 100.0%
Number of Pokemon in deck 53 Percentage of True: 100.0%
Number of Pokemon in deck 54 Percentage of True: 100.0%
Number of Pokemon in deck 55 Percentage of True: 100.0%
Number of Pokemon in deck 56 Percentage of True: 100.0%
Number of Pokemon in deck 57 Percentage of True: 100.0%
Number of Pokemon in deck 58 Percentage of True: 100.0%
Number of Pokemon in deck 59 Percentage of True: 100.0%
Number of Pokemon in deck 60 Percentage of True: 100.0%
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The second Monte Carlo simulation is testing conditional probability. We still have a deck of 60 cards, but we have 15 pokemon in the deck. Other than the hand and deck, we have a prize pile of 6 cards. We want to know the probability of having a pokemon in our hand similar to the first simulation, but we also want to know the probability of a rare candy trainer card being in the prize pile if there is a pokemon in hand. For this case, we have 15 pokemon, 1 rare candy, and the rest energy cards. We want to test this probability by having 1 rare candy on deck all the way up to 4. The amount of pokemon stays the same for each. This is testing conditional probability.

$$P(A \mid B)$$

The program tests each case 1,000,000 times to get the most accurate results. The program gets the percentage of B which is the probability of a pokemon being in the deck. The second thing it calculates is the conditional probability. Using the program and counters, we increment the counters when one occurs. Since the prize pile is only checked if having a pokemon is true, the count of prize pile truths gives us the conditional probability. Therefore, the program is calculating $P(A|B)$.

```
The probability of getting a pokemon in hand is: 88.223%
The probability of getting a rare candy in prize pile given there is a pokemon in hand is: 8.8865%
The probability of getting a pokemon in hand is: 88.28%
The probability of getting a rare candy in prize pile given there is a pokemon in hand is: 16.9506%
The probability of getting a pokemon in hand is: 88.2745%
The probability of getting a rare candy in prize pile given there is a pokemon in hand is: 24.4275%
The probability of getting a pokemon in hand is: 88.2639%
The probability of getting a rare candy in prize pile given there is a pokemon in hand is: 31.1958%
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Initially, I had the logic of my program to test if just ONE rare candy is in the prize pile. While this holds for one card being in the deck, this does not hold when there are multiple cards. I tweaked the logic of my program to return the amount of rare candy cards in the prize pile. Then in my run method, I changed the condition to ensure the amount of rare candies in the deck is equal to the number of rare candies that we have in the prize pile. It must be noted that when all rare candy cards are in the prize pile, the deck is bricked.
This is the output of the tweaked logic of the program. As the output shows, the case of having one card in the deck holds true while the others do not. This is the updated and correct information. It must be noted that we draw the prize pile first then the hand. Switching these around may make the numbers slightly different.

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The probability of getting a pokemon in hand is: 88.2802%
The probability of all rare candy cards in prize pile given there is a pokemon in hand is: 8.9002%

The probability of getting a pokemon in hand is: 88.2457%
The probability of all rare candy cards in prize pile given there is a pokemon in hand is: 0.773%

The probability of getting a pokemon in hand is: 88.1943%
The probability of all rare candy cards in prize pile given there is a pokemon in hand is: 0.0534%

The probability of getting a pokemon in hand is: 88.1942%
The probability of all rare candy cards in prize pile given there is a pokemon in hand is: 0.0038%
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