Math 107 - Project #4
Due: Monday, March 7th

This project has two separate parts. Write or type your neat and complete answers on a separate sheet. Be sure to ask questions if you have them! I am more than happy to help.

1. **Candy Color Distribution:**

   (a) Make a frequency table and a histogram for your sample of mini M&Ms. In your frequency table, show the frequency and relative frequency (rounded to the nearest percent) for each color. (You do not need cumulative frequencies.)

   (b) An online source says that the color distribution for regular M&Ms is:
   Brown: 30%
   Red, Yellow: 20% each
   Orange, Green, Blue: 10% each
   Given your sample, do you think it is likely that Mini M&Ms have the same color distribution as regular M&Ms? Why or why not?

   (c) Suppose you close your eyes and draw Mini M&Ms from the container. Given your sample distribution, answer the following.

      i. What is the probability that if you draw one Mini M&M, it will be green?

      ii.
      - State whether the events "picking a red M&M" and "picking an orange M&M" are overlapping or non-overlapping.
      - If you are drawing only one M&M from the container, what is the probability of picking a red M&M OR an orange M&M?
      - If you are drawing only one M&M from the container, what is the probability of picking a red M&M AND an orange M&M?

      iii. What is the probability of drawing 3 green M&Ms in a row from your container? (Without replacement)

      iv. Suppose you draw 5 M&Ms from the container. What is the probability that at least one of them is brown? (Without replacement)

      v. Suppose you draw 3 M&Ms from the container. What is the probability that one is blue, one is red, and the other is green? (The three colors can be drawn in any order.)

2. **Probability Calculations:** Take a look at the website for the Washington State Lottery www.walottery.com. In particular click on the "Games" link at the top. Then select "Powerball." This link displays how the game works and the odds/probabilities of winning.
Note: The current jackpot for Powerball this week is $20 million.

   From looking at the site, you can see that Powerball is played selecting 5 numbers from 1 through 59. For the first 5 numbers, 5 balls are selected randomly from a machine. The powerball is a single ball that is selected out of an entirely different machine with balls that range from 1 to 39. If you match all the numbers on the ball, you win the jackpot. Other prizes are available if you match some, but not all, of the balls.

   (a) How many different 6 ball combinations are available for someone to choose? **Show your calculations.**
   (Remember, the powerball is chosen differently from the other balls.)

   (b) Given your answer to part (a), what is the probability that one ticket will be a jackpot winner?
   (Note: Your answer should match what is shown on the lottery website. You do not need to compute the probabilities of all the other prizes.)

   (c) With a current jackpot of $20 million, what is the current expected value of buying a $1 ticket and playing powerball?
   (You have to take into account all the possible prizes, the cost of the ticket, and the probability of each outcome.)

   (d) Given your answer to part (c), how much can the lottery commission anticipate to gain (approximately) from selling one million $1 tickets?

   (e) Note that below the prizes and odds, it says that the overall odds of winning some prize is approximately $1/35.1 \approx 0.02849$. Verify that this is true given the odds listed for all the other prizes.
   (Hint: We are essentially looking for the probability that you will win the jackpot or $200,000 or $10,000 or .... or $3.)