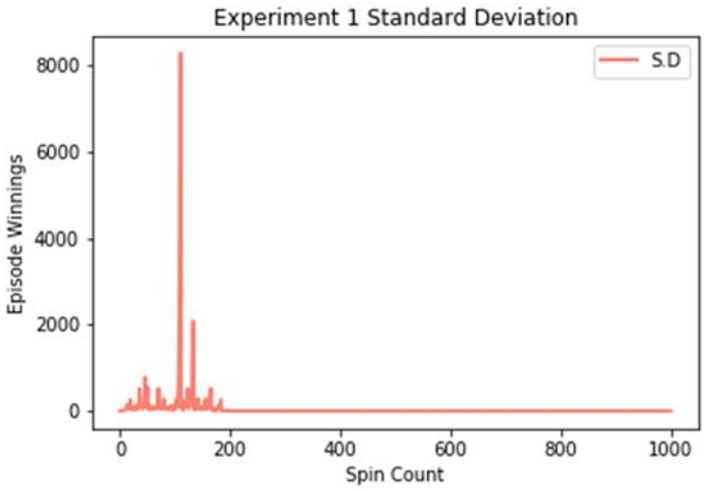
Project 1 – A Gambling Simulator

1. In Experiment 1, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning.
   The probability of winning $80 within sequential 1000 bets is **1**.
   Running the experiment multiple times reveals that, every time $80 wining is reached. According to the algorithm, $X loss can always be earned back after a successive single win. So, it is always possible to reach a $80 winning for a N number of successive bets, when N is a large number as 1000.

2. In Experiment 1, what is the estimated expected value of our winnings after 1000 sequential bets? Explain your reasoning. Go here to learn about expected value: https://en.wikipedia.org/wiki/Expected_value
   The estimated expected value of our winnings after 1000 sequential bets is **80**.
   As explained in question 1, the probability of winning $80 is 1, so, 80 is the value which is always going to occur in each run.

3. In Experiment 1, does the standard deviation reach a maximum value then stabilize as the number of sequential bets increases? Explain why it does (or does not).
   No.
   Standard deviation is the amount of variation of a set of values. Since there is no lower limit for the value of winnings, the graph shows dynamic variations as the number of sequential bets increases until the winnings reach $80. From that point, the winnings remain the same from then on, so the standard deviation flattens to 0. Please find the graph below.



4. In Experiment 2, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning.

   The probability of winning $80 within 1000 sequential bets is 0.626.

   Running the experiment multiple number of times over varied N runs, I get the values as,

   Probability = No of occurrences of $80 within 1000 sequential bets / 1000

No of runs	Probability of winning $80
10	0.6
100	0.62
1000	0.622
10,000	0.646
100,000	0.646
Average Probability	0.626

5. In Experiment 2, what is the estimated expected value of our winnings after 1000 sequential bets? Explain your reasoning.

   The estimated expected value of our winnings is -47.008.

The expected value is the summation of the product of the value and the probability of occurrence of the value.

Expected Value = (80 * Probability of winnings as 80 after 1000 sequential bets) + (-256 * Probability of winnings as -256 after 1000 sequential bets)

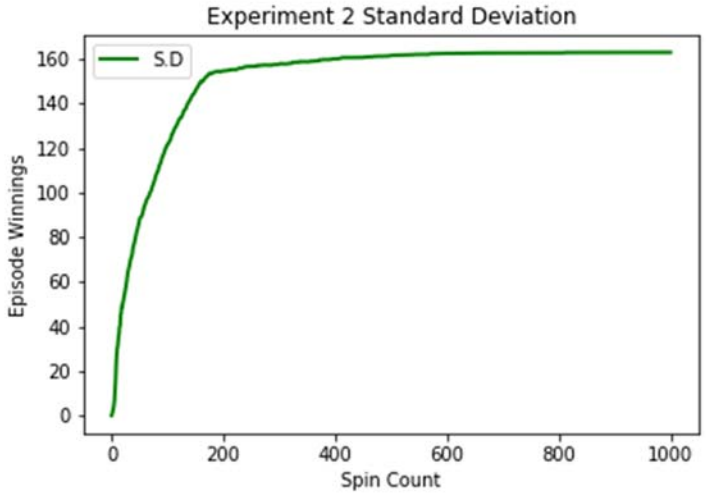
Running the experiment for 1000 runs, I get the values as,

Expected Value = (80 * 0.622) + (-256 * 0.378)

6. In Experiment 2, does the standard deviation reach a maximum value then stabilize as the number of sequential bets increases? Explain why it does (or does not).

   Yes.

   From the graph below, we can see that the standard deviation reaches a maximum value then stabilizes as the number of sequential bets increases. Since in experiment 2, we set the upper limit as 80 and the lower limit as -256, after some point, the value of winnings either fixes as 80 or -256. This gives stable standard deviation values from then on.



7. Include figures 1 through 5.

   Please find below the figures from experiments 1 and 2.

Figure 1

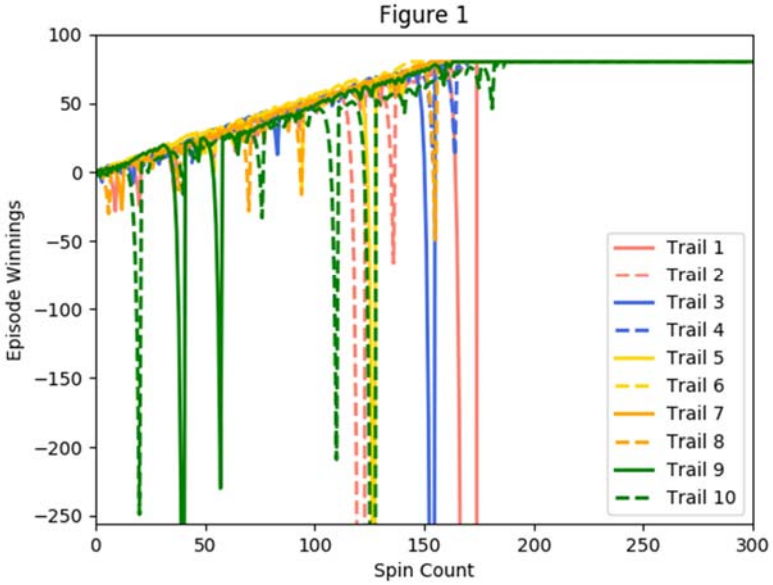


Figure 2

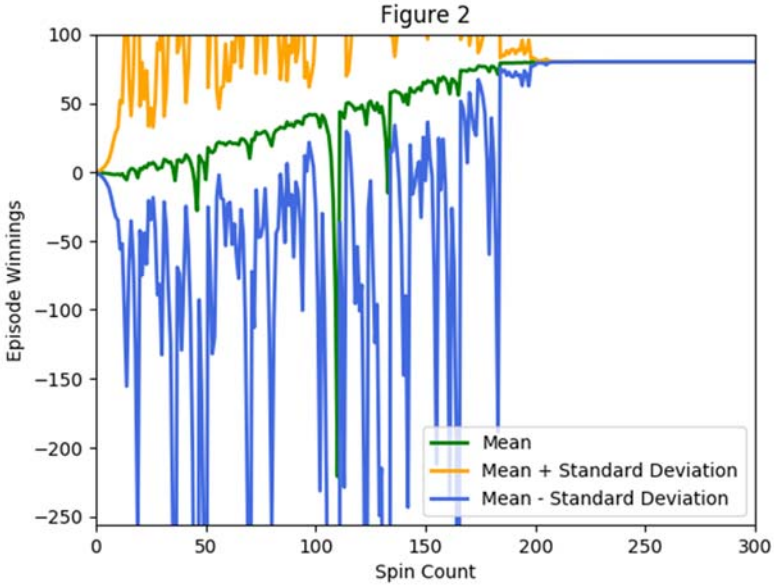


Figure 3

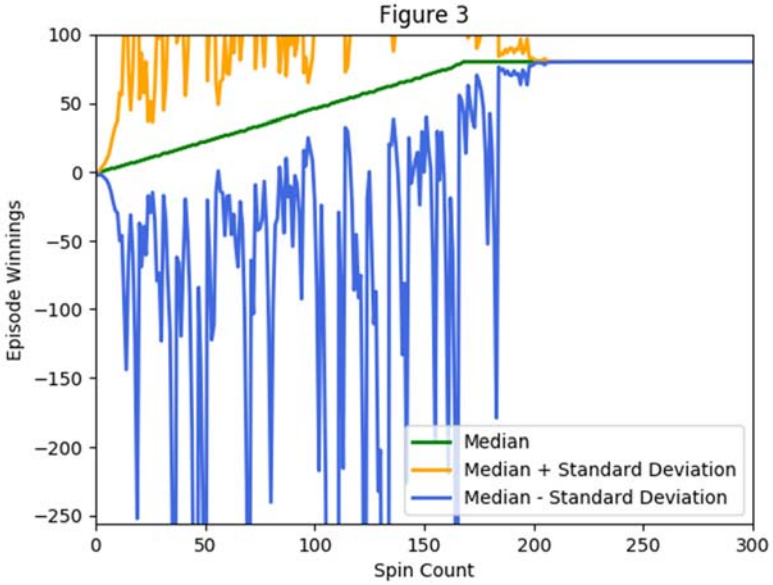
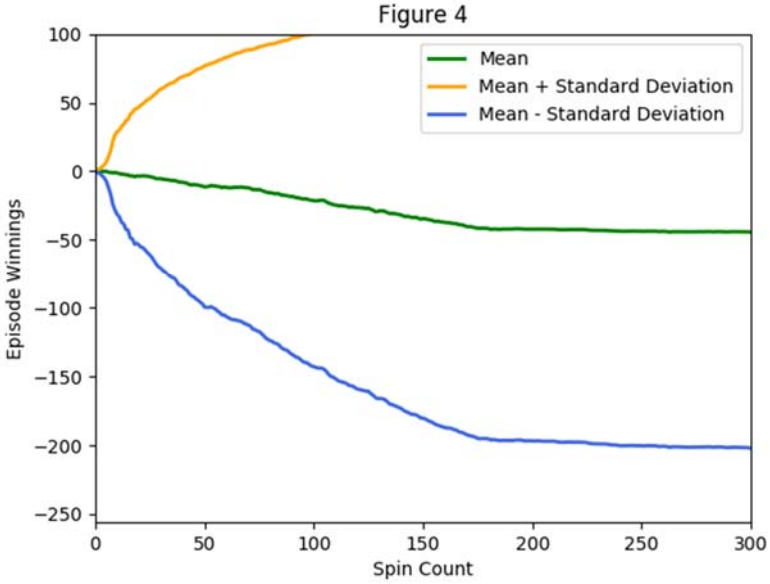
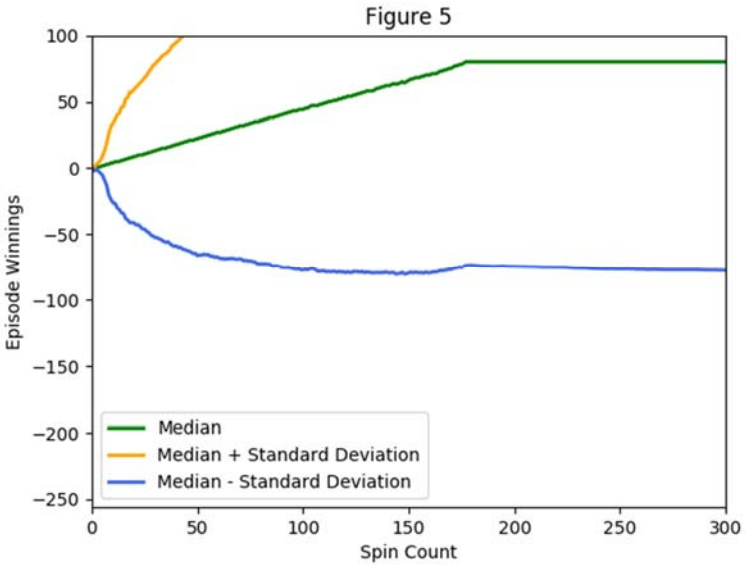


Figure 4





Citations:

"Expected Value in Statistics: Definition and Calculations." Statistics How To, www.statisticshowto.datasciencecentral.com/probability-and-statistics/expected-value/.

"Standard Deviation." Wikipedia, Wikimedia Foundation, 11 Jan. 2019, en.wikipedia.org/wiki/Standard_deviation.

"Snakify - Python 3 Interactive Course." Strings - Learn Python 3 - Snakify, snakify.org/en/lessons/two_dimensional_lists_arrays/.

Holtz, Yan. "#122 Multiple Lines Chart." The Python Graph Gallery, 1 Aug. 2017, python-graph-gallery.com/122-multiple-lines-chart/.

"Numpy.mean¶." Scipy.stats.trim_mean - SciPy v1.1.0 Reference Guide, docs.scipy.org/doc/numpy-1.13.0/reference/generated/numpy.mean.html?highlight=mean#numpy.mean.

"Numpy.std¶." Scipy.stats.trim_mean - SciPy v1.1.0 Reference Guide, docs.scipy.org/doc/numpy-1.13.0/reference/generated/numpy.std.html.

"Setting the Title, Legend Entries, and Axis Titles." Modern Visualization for the Data Era - Plotly, plot.ly/matplotlib/figure-labels/.