Project 1 Martingale Report

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American wheel has 18 black, 18 red, and 2 zeros. So the chance of winning a bet is 18/(18+18+2) = 0.473684

1.In Experiment 1, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning.

The probability of winning $80 within 1000 sequential bets is near 100%. The simulation shows all of the 1000 runs have won $80.

The chance of making k win from n trials follow Binomial distribution. The chance of loosing is the chance that the numbers of wins is less than 80. Using the following code

```
    lost_chance = 0
    for k in range(80):
        lost_chance = lost_chance + factorial(n) / factorial(k) / factorial(n - k) *
win_prob ** k *(1-win_prob) ** (n-k)
print 'chance of not making $80 is ' + str(lost_chance)
```

The chance of making less than $80 is only 2.23247469202e-164, it is extremely small. So we have almost 100% of winning $80

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 all of the runs reach $80. The possibility for each run to reach $80 is almost 100%.

3. In Experiment 1, does the standard deviation reach a maximum value then stabilize or converge as the number of sequential bets increases? Explain why it does (or does not).

The standard deviation will reach to 0 because all the the value will be $80 as the number of bet increases. There will be no variation so the standard deviation will be 0. But it fluctuates before that.

4. In Experiment 2, estimate the probability of winning $80 within 1000 sequential bets. Explain your reasoning using the experiment. (not based on plots)

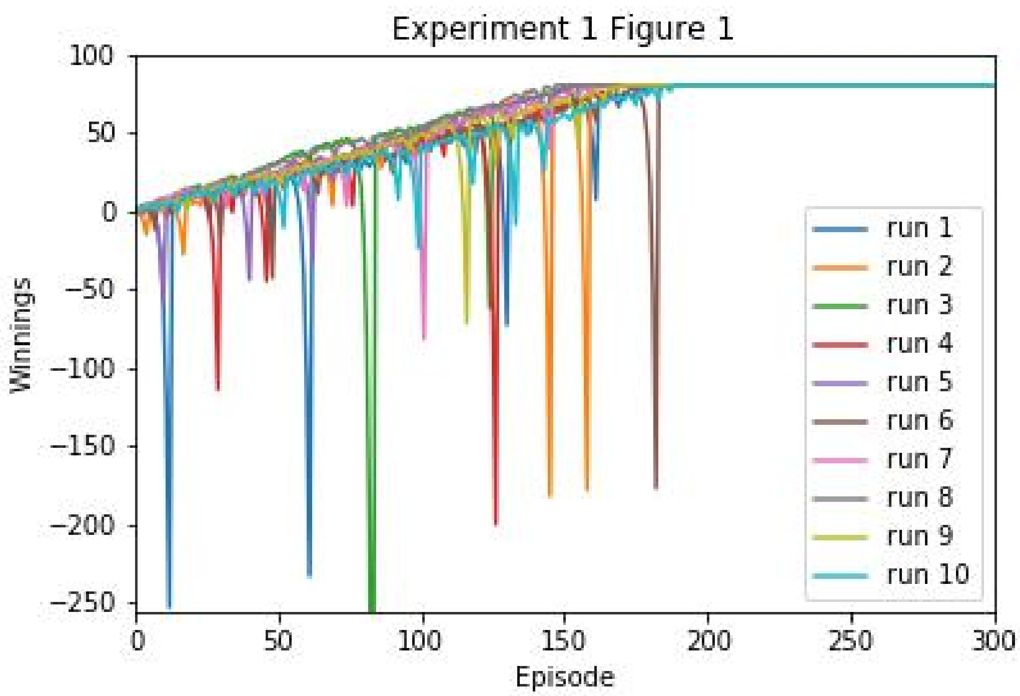
From experiment 2, 655 of the 1000 runs have winnings of $80 using bank roll of $256. So the probability of winning $80 within 1000 sequential bets is 65.5%

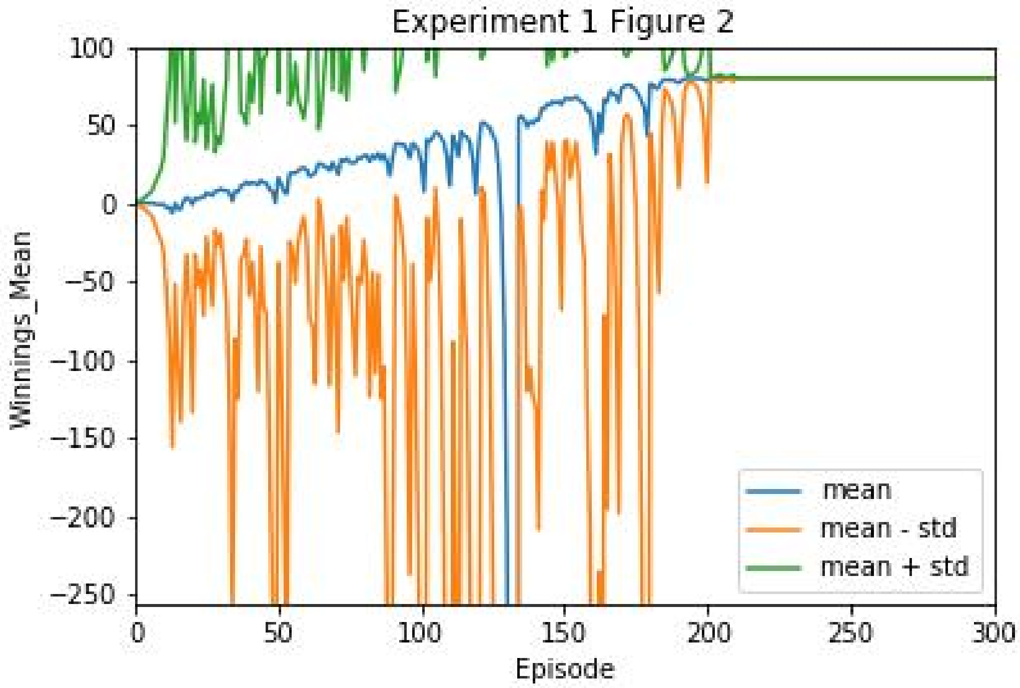
5. In Experiment 2, what is the estimated expected value of our winnings after 1000 sequential bets? Explain your reasoning. (not based on plots)

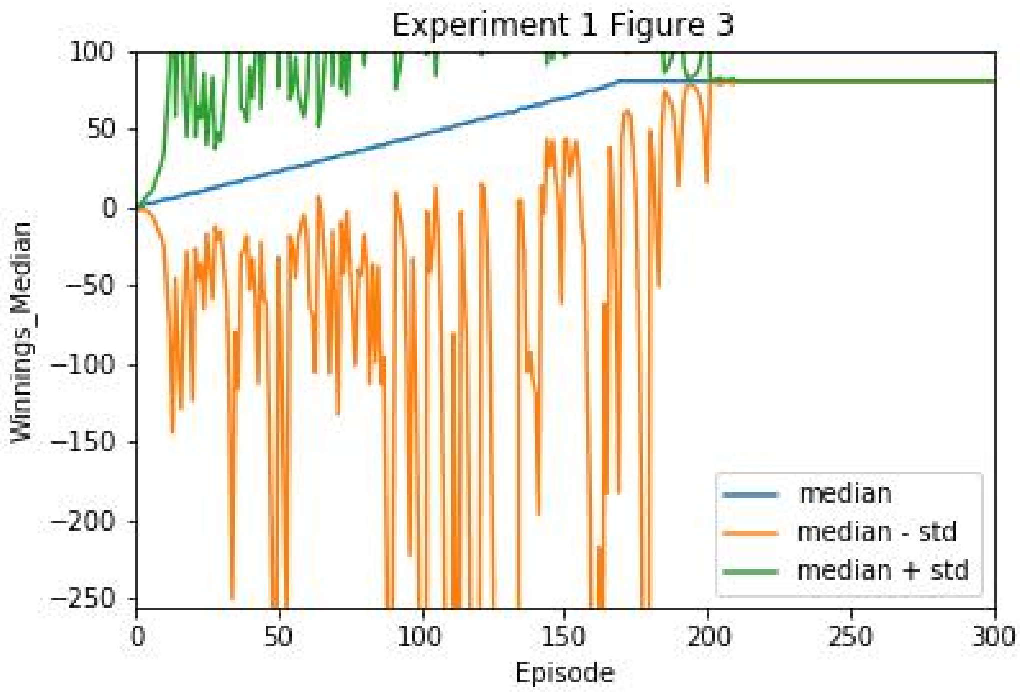
The estimated expected value of our winnings after 1000 sequential bets is -$35.92. From the simulation in Experiment 2, the mean is -$35.92 after 1000 bets from 1000 simulation runs.

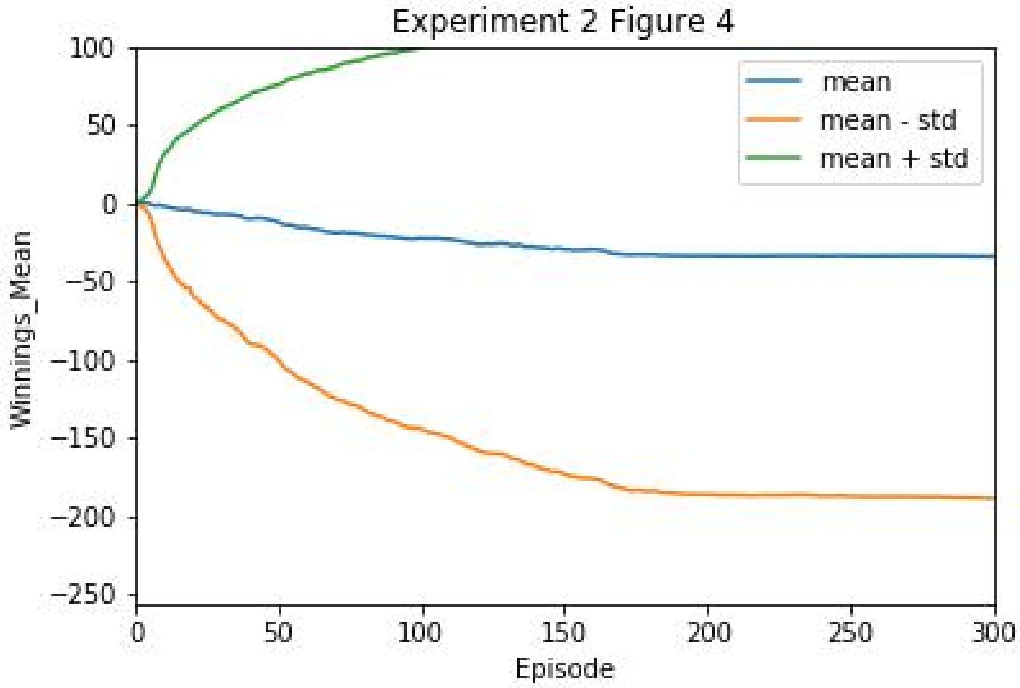
6.In Experiment 2, does the standard deviation reach a maximum value then stabilize or converge as the number of sequential bets increases? Explain why it does (or does not).
The standard deviation reaches a maximum value then stabilizes. It is because after curtain bets, they will be no changes in winnings, either because they lost all of the bank roll or has won $80. The winnings will become -$256 or $80

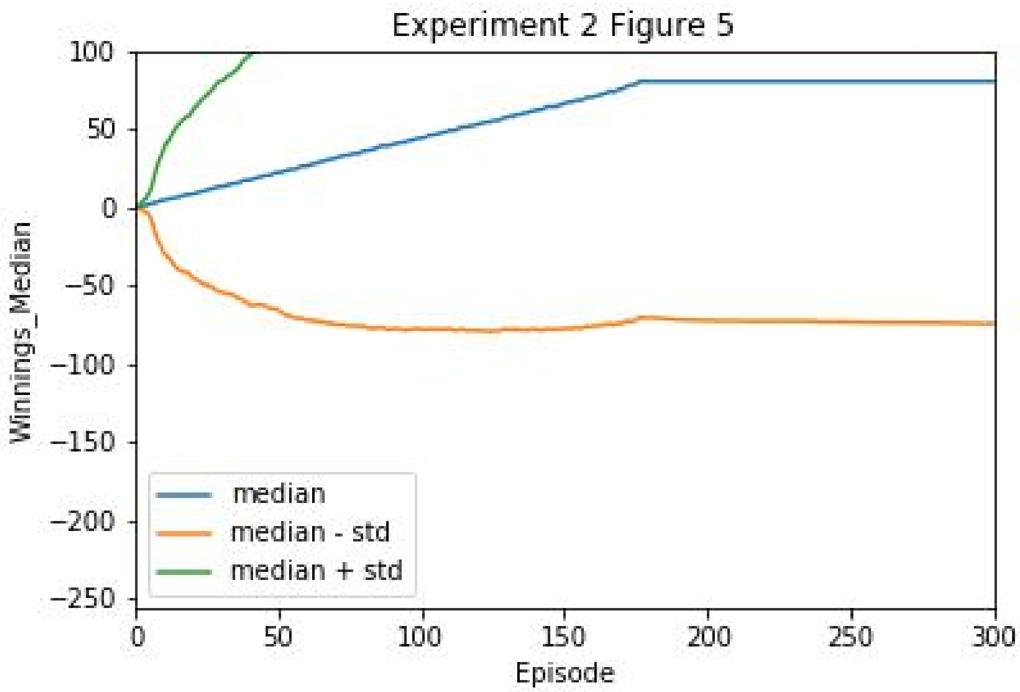
6. Include figures 1 through 5.




Experiment 1 Figure 2
Winnings_Mean
Episode
mean
mean - std
mean + std
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300


Experiment 1 Figure 3
Winnings_Median
Episode
median
median - std
median + std
100
50
0
−50
−100
−150
−200
−250
0
50
100
150
200
250
300


Experiment 2 Figure 4
100
50
0
−50
−100
−150
−200
−250
Winnings_Mean
0
50
100
150
200
250
300
Episode
mean
mean - std
mean + std


Experiment 2 Figure 5
100
50
0
−50
−100
−150
−200
−250
Winnings_Median
0
50
100
150
200
250
300
Episode
median
median - std
median + std