Martingale Strategy for 2 mans in PrizePicks

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2024-03-21

Idea:

- The idea of the martingale strategy is to start off with some initial betting size
- If we lose the bet, we double our betting size for the next bet
- We continue doubling our betting size until we win a bet
- Once we win a bet, our next bet will be back to the initial betting size
- We will bet only 2 man power plays on PrizePicks. The payout for winning is 3 times what you put in. You win a bet if both players in your parlay hit. Even if one player doesn't hit their line, you lose the money that you put into that bet.

Calculations and Variables:

- Let **I** represent our initial betting size
- Let **T** represent our total bankroll
  - If we go on a long enough losing streak that causes us to lose our entire bankroll, we call this event "ruin"
- Let **N** represent the total number of bets we can afford to consecutively lose before ruin
- We can calculate **N** in terms of **I** and **T** as follows…

$$N = \lceil \log_2 \left(\frac{T}{I} + 1 \right) \rceil$$

- Now let **p** represent the average probability of a given leg of a bet hitting, then the probability that a given bet will hit can be calculated as follows…

$$P(hit) = p^2$$

- Then we can also calculate the probability of a given bet missing…

$$P(miss) = 1 - P(hit) = 1 - p^2$$

- Now we can calculate the probability of reaching ruin:

$$P(ruin) = (1 - p^2)^N$$

- For a given martingale series, we can calculate the profit we get when we win on the nth bet in the series:
  - If we win our first bet (n = 1), we get $3I - I = 2I$ in profit
  - If we win our second bet (n = 2), we get $6I - 2I - I = 3I$ in profit
  - when n = 3, we get $12I - 4I - 2I - I = 5I$ in profit
  - when n = 4, we get $24I - 8I - 4I - 2I - I = 9I$ in profit

- From the pattern above, we see that winning the nth bet in a series gives us the following profit...

$$(2^{n-1}I) + I$$

- Our goal is to calculate the expected value for this martingale system. The expected value can be calculated by summing the probabilities of each event occurring times the profits earned from those events. We can split our expected value equation into two parts. The part where we don't reach ruin, and the part where we do reach ruin. Let **X** be a random variable that represents our profit for a given martingale series, then we get...

$$E(X) = E(noruin) + E(ruin)$$

- We focus on the non-ruin part first:

$$E(noruin) = \sum_{i=1}^{N} \big(((2^{i-1}I) + I)(1-p^2)^{i-1}(p^2)\big)$$

- Now the ruin part:

$$E(ruin) = -T(1-p^2)^N$$

- We sum the expectations to get our final expectation:

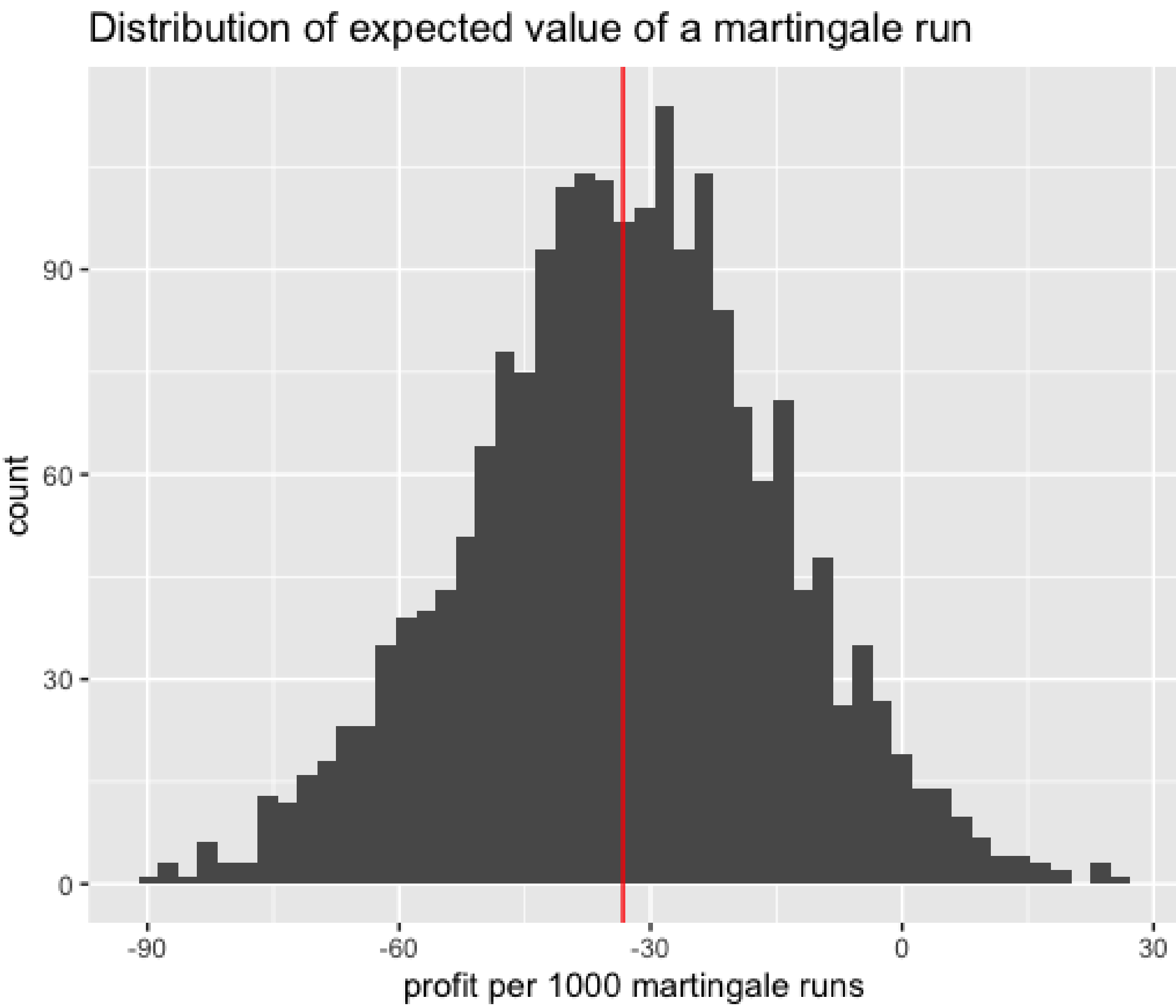
$$E(X) = \sum_{i=1}^{N} \big(((2^{i-1}I) + I)(1-p^2)^{i-1}(p^2)\big) - T(1-p^2)^N$$

Finding if the strategy is profitable:

- Now we replace the variables with approximate realistic values and see if it leads us to a positive expected value in the long run
- If we were to place bets blindly, each leg would have a 50% chance of hitting, however, since we are using the optimizer and intuition, let's say each leg has an average of 54% chance to hit, thus $p = 0.54$
- Let $I = 5$, since this is the minimum unit size allowed on PrizePicks
- Our total bankroll will be $T = 2555$, as this is the minimum bankroll required to be able to place a series of $N = 9$ consecutive losing bets before reaching ruin
- Now plugging in all those numbers, we get the following:

$$E(X) = \sum_{i=1}^{9} \big(((2^{i-1}5) + 5)(1-0.54^2)^{i-1}(0.54^2)\big) - 2555(1-0.54^2)^9 = -33.046$$

- We see that with these parameters, for a given martingale series our expected value is **-$33.05**
- To confirm our calculations, we run a simulation of 10,000 martingale runs and calculate the average profit earned. We repeat this process n = 2,000 times so that we now have a vector with 2,000 observations of average profit earned. We then plot the distribution of expected average profits. We expect to see an approximately normal distribution (due to the Central Limit Theorem) with $mean = E(X) = -33.046$



- The simulation gives us a mean value of -33.298, which is close enough to agree with our expected value of -33.046. It shows that our calculations are correct.

What would it take to make the martingale strategy profitable?

- What value of **p** would make the martingale strategy the most profitable?
- If we graph the expected profit of a martingale series as a function of p, where p takes on values in the interval [0, 1], we see that when $p = 0.577$, we break even in the long run.
- The expected value reaches its maximum of **+$23.77** when **p = 0.673**
- Note that expected profit does not strictly increase as p increases. For example, if **p = 1**, that means we would hit the first bet every single time for a given run, which makes our expected profit **+$10**

Conclusion:

- The martingale strategy is profitable only if $p > 0.577$, but this is the same percentage required for any 2 man power play to be profitable, so if you're gonna try the martingale strategy with bets where p > 0.577, you might as well just place it normally with a constant unit size and you'll still be profitable.

- So in conclusion, the martingale strategy is stupid. Maybe if the payout was 3.5x instead of 3x or something then the expected value would be positive, but unfortunately it's not.