

## Oxford University Maths Essay Competition 2026

There is a pervasive myth whispered over slot machines and etched into the furrowed brows of roulette players: the belief in "The Correction." After a staggering streak of losses, the gambler leans in, feeds another note into the machine, and mutters the four most dangerous words in mathematics: "I'm due for a max win." This sentiment is the lifeline of the Gambler's Fallacy; a psychological trap built on a conceptual distortion of how randomness works. We are a species evolved to find patterns in the chaos. When faced with a "memoryless" system, intuition tends to believe in a balancing act where a string of "Reds" must inevitably be followed by a "Black" to grant financial freedom. The Random Number Generator does not feel guilt for your empty pockets, or to exponentially growing debt repayments, which you owe. This essay will peel back the curtain on the "Max Win" illusion, by exploring the divergence between the Law of Large Numbers and the human delusion.

### Blackjack

Blackjack is fundamentally a game of dependent events, where the removal of cards from a finite deck creates a non-stationary stochastic process. Unlike games with independent trials, the probability of future outcomes is conditional upon the history of the deck, described by the transition probabilities of a Markov Chain. A player's "Basic Strategy" is the result of recursive calculations—often utilizing dynamic programming—to determine the move that maximizes the Expected Value (EV) for any given hand-state. Card counting systems, such as the Hi-Lo method, serve as a heuristic for tracking the effect of removal of cards in a shoe. Mathematically, as high-value cards (10s and Aces) remain in the deck, the dealer's probability of "busting" on a mandatory hit increase, shifting the game's variance in favour of the player and allowing for a positive expectation where  $E(X) > 0$ , which gives the house a greater incentive to play event if deep into losses, the feeling of greater knowledge gives an illusion against the random variables which are often ignored.

|             | A  | 2    | 3  | 4  | 5    | 6  | 7     | 8  | 9    | 10 | BC  | PE  | IC  |
|-------------|----|------|----|----|------|----|-------|----|------|----|-----|-----|-----|
| Hi-Lo       | -1 | +1   | +1 | +1 | +1   | +1 | 0     | 0  | 0    | -1 | 97% | 51% | 76% |
| Hi-Opt I    | 0  | 0    | +1 | +1 | +1   | +1 | 0     | 0  | 0    | -1 | 88% | 61% | 85% |
| Hi-Opt II   | 0  | +1   | +1 | +2 | +2   | +1 | +1    | 0  | 0    | -2 | 91% | 67% | 91% |
| KO          | -1 | +1   | +1 | +1 | +1   | +1 | +1    | 0  | 0    | -1 | 98% | 55% | 78% |
| Omega II    | 0  | +1   | +1 | +2 | +2   | +2 | +1    | 0  | -1   | -2 | 92% | 67% | 85% |
| Red Seven   | -1 | +1   | +1 | +1 | +1   | +1 | 0/+1* | 0  | 0    | -1 | 98% | 54% | 78% |
| Revere PC   | -2 | +1   | +2 | +2 | +2   | +2 | +1    | 0  | 0    | -2 | 99% | 55% | 78% |
| Uston APF   | 0  | +1   | +2 | +2 | +3   | +2 | +2    | +1 | -1   | -3 | 91% | 69% | 90% |
| Wong Halves | -1 | +0.5 | +1 | +1 | +1.5 | +1 | +0.5  | 0  | -0.5 | -1 | 99% | 56% | 72% |
| Zen Count   | -1 | +1   | +1 | +2 | +2   | +2 | +1    | 0  | 0    | -2 | 96% | 63% | 85% |

[https://en.wikipedia.org/wiki/Markov\\_chain](https://en.wikipedia.org/wiki/Markov_chain)