What were the Odds of Having Such a Terrible Streak at the Casino?

Go into any casino, or start any conversation about gambling and you are bound to hear people talking about winning or losing streaks. "I was doing so well and then suddenly lost 6 times in a row and was bankrupt. What are the odds of that?" or "After I was playing for an hour, I was on fire and I won 9 times in a row. It's incredible!". Streaks are usually seen as amazing.

Professor Emeritus Ted Hill of Georgia Tech used to divide up his class in half using a criteria unknown to him. Half the class was assigned to flip a coin 200 times and dutifully record a list of H's or T's for heads or tails. The other half of the class was told to go home and fill out a paper with a list of 200 H's or T's. His big trick was when they turned in the papers he could tell with almost perfect accuracy which papers were faked and which ones were real data. The general moral was that most people didn't understand the nature of random data very well. Your average person knows nothing about the probability of streaks.

People tend to think of a run of 6 or more heads or tails in a row as an extraordinary event. If you are calculating odds the odds of having all heads or all tails with 6 tosses of a coin are 1/32. People who fake data without any prior mathematical knowledge of odds tend to stop runs at 4 or 5 H's or T's. In reality, the longer you keep flipping the coin, the more and more likely it is that you will get longer and longer streaks. A run of 200 coin tosses reduces the probability of NOT getting a run of at least 6 to only 3.47%. The professor simply divides the papers into two piles depending if they have a streak of 6 or more and those without any streaks. To a high degree of accuracy the ones without streaks are fake data, and the ones with streaks are real data.

So the gamblers who are amazed at streaks should not be. What would be amazing is if there weren't any streaks. What makes matters worse is that losing streaks are far more common than winning streaks. That's because you are far more likely to lose most casino games than to win. In many games, the house tends to pay bonuses to reduce the house edge from straight winning or losing (i.e. blackjacks usually pay an extra 50%, a crap line bet pays double or triple on a 2 or a 12, etc.).

This misconception is worth billions of dollars every year in gaming revenue. Usually gamblers get excited on winning streaks and they keep gambling. Inevitably the losing streak comes and they either lose their winnings or their bankroll.

It's possible to invent a simple scheme that exploits this misconception. Roll six dice and lay them out in a row. You win if three or more in a row are evens or odds. You opponent wins if there is no streak. Most people will take the bet thinking it's either a fair bet or they have the advantage. In reality the odds are 19 to 13 in favor of a streak of 3 or more. Because there are only 64 combinations you can actually write them all out and count them to derive the odds yourself.

The mathematics of this calculation for arbitrary values is surprisingly complex. Simple counting theory doesn't work. It's not a binomial distribution since the probability of a streak is not an independent event. The answer can be calculated using a discrete time Markov chain.

I have never seen the curves resulting from the calculations presented on a website or in a textbook. I am presenting a series of curves that show the probabilities of streaks of 3,4,5,6,7,8, and 9 heads or tails in a row for up to 200 coin tosses (or another random event with 50/50 probability). From the curves, you can see that not only is there a 96.5% probability of getting 6 in a row out of 200 tosses, but there is also an 80% probability of getting 7 in a row, a 54% probability of getting 8 in a row, and a 32% probability of getting 9 in a row. The next time you are in a casino and you have a sudden massive losing streak, you should say to yourself, "What else would you expect?".

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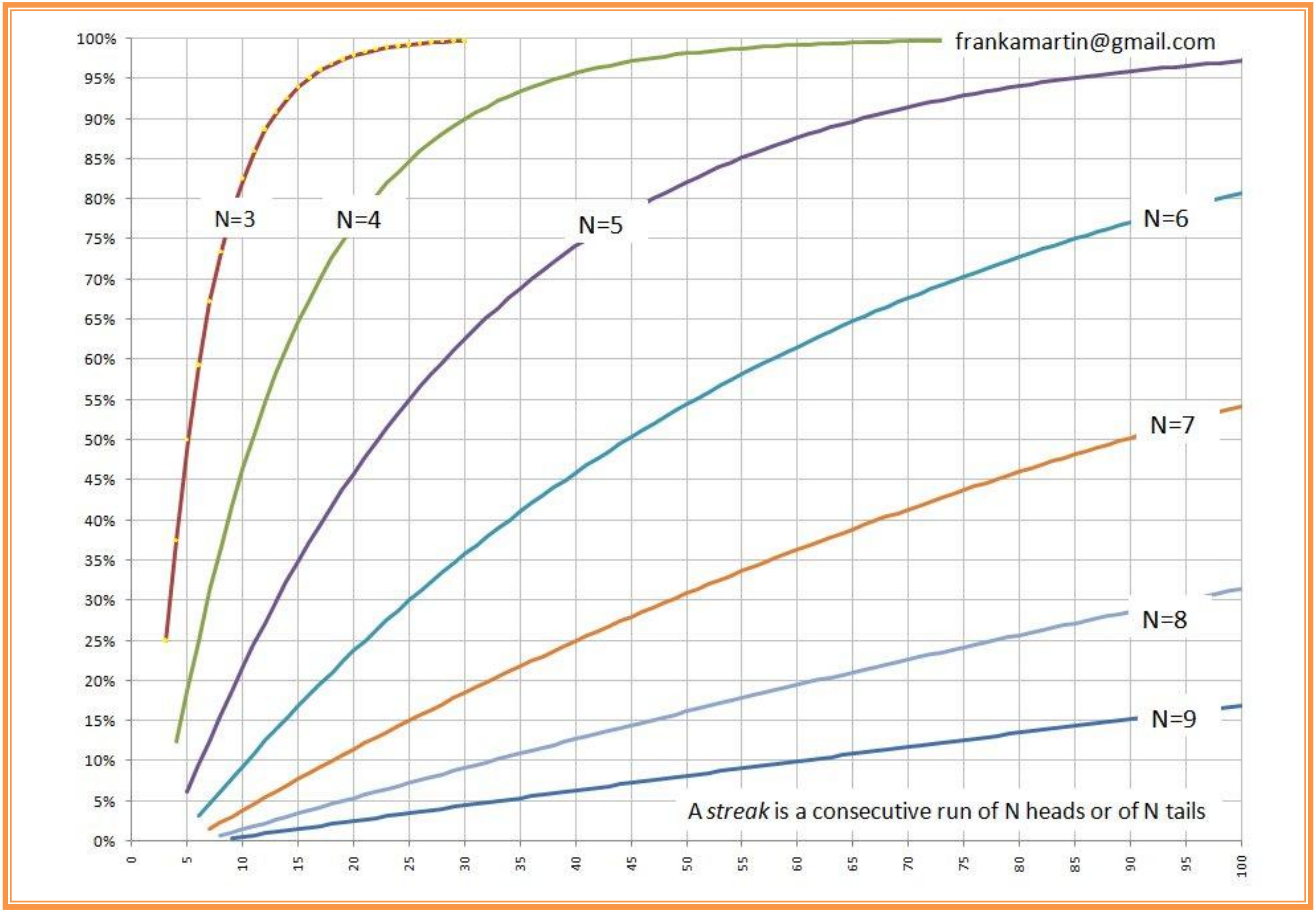
Probability of Getting A Streak of *N* Heads or *N* Tails Out of Up to 100 Coin Tosses



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Probability of Getting A Streak of *N* Heads or *N* Tails Out of Up to 1,000 Coin Tosses (log scale)