

# Re: Coin tossing guessing strategy...

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*Source:* <http://sci.tech-archive.net/Archive/sci.math/2008-04/msg04072.html>

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- *From:* Chula Pittayapinun <pastelsalad@xxxxxxxx>
  - *Date:* Tue, 22 Apr 2008 05:51:26 -0700 (PDT)
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On Apr 21, 7:55 pm, quasi <qu...@xxxxxxxx> wrote:

On Tue, 22 Apr 2008 00:39:43 -0700 (PDT), Chula Pittayapinun

<pastelsa...@xxxxxxxx> wrote:

On Apr 21, 6:19 am, quasi <qu...@xxxxxxxx> wrote:

On Mon, 21 Apr 2008 10:57:54 -0700 (PDT), Chula Pittayapinun wrote:

On Apr 21, 5:27 am, Ray Vickson <RGVick...@xxxxxxxx> wrote:

ANY \*particular\* string, such as HTTHHHTHTHTT has the same probability of occurrence as any other string of the same length, such as HHHHHHHHHHHH or TTTTTTTTTTTT (strings of length 12 in this case). It is true that strings of length 12 that have 5 heads and 7 tails are much more probable than all H or all T, but that is not what we are talking about here. You

Re: Coin tossing guessing strategy...

need a precise string in exactly one order, because according to your description of the game, you lose as soon as the element in the  $n$ th position (H or T) fails to match the actual result of the  $n$ th toss, if you have not already lost before the  $n$ th toss. Just guessing the right number of H's and T's is not good enough.

That is what I also thought. But could you please elaborate on 'that is not what we are talking about here'? I need a precise formal argument, if possible, to explain to my friends. (One of them has invoked the argument of random walk— that HHH...H has lower prob of occurrence than HTTHHHTTTT.)

Coins have no memory.

Moreover, a coin is blind.

How would a coin even know whether it came up H or T?

The simplest way to defeat these fools who think a fair coin is biased with respect to sequences of  $n$  flips, is to note that if some sequence of say 10 flips was more likely than some other sequence of 10 flips, then a similar bias (possibly a little less) should hold for 9 flips, right? In other words, it's not reasonable to claim the bias

Re: Coin tossing guessing strategy...

happens  
only for  $n > 9$ . Once you convince your challenger that  $n = 9$   
would  
also show a bias, then ask what about  $n = 8$ ? When you reach  
 $n = 2$ , get  
out some coins and experiment. Does your challenger really  
believe any  
of the 4 sequences HH, HT, TH, TT is more likely than any  
other?

There's something dependent on the order of  $n$  in the argument of one-dimensional random walk (please refer to wiki page of the topic 'random walk'), although I'm not sure how that argument is related to this problem. Furthermore: 'for any random walk in one dimension, every point in the domain will almost surely be crossed an infinite number of times.' Does this mean that the longer the string (as  $n$  approach  $\infty$ ), it is more likely that the number of H's will equal T's? If not, then why is it not applicable in this problem setting?

Read my prior explanation.

For 2 coins, do you think there a bias, even a slight bias with respect to the 4 possible sequences HH, HT, TH, TT?

If not, then why would you think a bias suddenly develops for a longer sequence, say a 10 coin sequence?

In fact, assuming a fair coin, all 10 coin sequences are equally likely.

Don't confuse the equiprobability of  $n$  coin sequences with the probability distribution for the difference between the number of heads and tails. Thus, for an  $n$ -term sequence, it's much more likely that the difference is 0 than  $n$ , but that has nothing to do with the game in question. You don't care about the totals. Effectively, you are asking if one particular  $n$  coin sequence is more likely than another. The answer is "no".

quasi

Hahaha what a way to settle an argument.

That's exactly what I am saying to them: each *\*particular\** sequence has equal probability of occurrence i.e.  $1/(2^n)$ . In fact, saying  $1/(2^n)$  is absurd since the past tosses are done and really don't count.

Re: Coin tossing guessing strategy...

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I found this well-explained argument in wiki article 'gambler's fallacy':

"Now suppose that we have just tossed four heads in a row. A believer in the gambler's fallacy might say, "If the next coin flipped were to come up heads, it would generate a run of five successive heads. The probability of a run of five successive heads is  $(1/2)^5 = 1/32$ ; therefore, the next coin flipped only has a 1 in 32 chance of coming up heads."

This is the fallacious step in the argument. If the coin is fair, then by definition the probability of tails must always be 0.5, never more or less, and the probability of heads must always be 0.5, never less (or more). While a run of five heads is only 1 in 32 (0.03125), it is 1 in 32 before the coin is first tossed. After the first four tosses the results are no longer unknown, so they do not count. The probability of five consecutive heads is the same as that of four successive heads followed by one tails. Tails isn't more likely. In fact, the calculation of the 1 in 32 probability relied on the assumption that heads and tails are equally likely at every step. Each of the two possible outcomes has equal probability no matter how many times the coin has been flipped previously and no matter what the result. Reasoning that it is more likely that the next toss will be a tail than a head due to the past tosses is the fallacy."

However, the above paragraph ends with the following 2 sentences:

"The fallacy is the idea that a run of luck in the past somehow influences the odds of a bet in the future. This kind of logic would only work if we had to guess all the tosses' results before they are carried out."

The last sentence is how the law of large numbers (or random walk concept) comes into play. They (my freinds) say, with big n, "HHH...H" is much less likely to occur than other \*specific\* strings with equal number of H's and T's.

Which is quite sound, so now I guess the problem is at "if we had to guess all the tosses' results before they are carried out.". So maybe the first question to ask is: is guessing the entire string of H's and T's before the tosses the same as guessing the tosses one by one after each toss?

That's why I said my problem might be ill-defined :(

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