eGambling
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letters

Understanding the Laws of Probabilities

We live in a world of chance or as the mathematicians call it, probability. We hear the weatherman say that the chance of rain tomorrow is 30 per cent, meaning that there is one chance in three that rain will fall. A doctor may say that a certain treatment has a 50-50 chance of success. That means in two cases, one should be successful. The chances of being killed in a commercial plane crash are one in 22 million flights.

Chance enters into gambling and some games are called games of chance. The lotteries are a form of gambling where the odds of winning the big jackpot are very poor. It is not uncommon for the odds of winning the largest prize to be one in five million or more. I will use the odds of *one in five million* chances to explain how I understand lotteries.

The chances of winning are so remote that one wonders what people are thinking when they spend their hard-earned money purchasing lottery tickets. Perhaps it takes two forms. Some may not understand chance, while others may not understand large figures – like what a million of something really is. Some may not understand either concept.

I have devised a method that may help us understand both large numbers and chance. It's a scenario where I purchase five million tongue depressors. I then take them to our local civic center and start off by pushing them into the ground an inch (2.54 centimetres) apart. I continue this over hill and dale, putting one tongue depressor in the ground every second, eight hours a day. I continue this for many miles. Every day of the week, I push those depressors into the soil. Finally, after 173 days (or 24.6 weeks) I place the last one. The distance covered by the five million depressors is 79 miles (127 kilometers).

But I haven't told you a secret. One of the five million depressors that was inserted into the earth has red paint daubed on the end of it.

Next, I find an avid lottery player and I show him the trail of depressors. I tell him that one of the sticks has red paint on the buried end. If he gives me a dollar and then pulls up the red-daubed one, I will give him a million dollars. Can you see him looking away farther than the eye can discern? Can you see him decide and then say, "What are you trying to tell me? I am to pick out the one with red paint from those over the whole 79 miles? You must think I'm crazy."

"No, mister, I don't think you are crazy. This just shows the chance you take when you invest in the lottery. Better by far to take the dollar, roll it up and stuff it in a rat hole. It might choke the rat."

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On Random Musings

In Issue 2 of the *Electronic Journal of Gambling Issues: eGambling:* *http://www.camh.net/egambling/issue2/research/index.html* Nigel Turner provides an interesting and informative overview of the nature of randomness and the origins of misunderstandings surrounding aspects of randomness. There is no doubt that cognitive schemas characterised by erroneous perceptions, irrational beliefs and distorted cognitions play a primary role in the maintenance of gambling and problem gambling behaviours in particular. This view is well articulated in the publications of key researchers and clinicians such as Robert Ladouceur, Michael Walker and Tony Toneatto and presented conceptually in the cognitive model offered by Sharpe and Tarrier. There is no contentious issue for debate within this context; beliefs are important ingredients fuelling the gambling urge.

However, on reading Nigel Turner's article, I mused over the concept of regression to the mean that was used to explain why the probability of a toss of coin gradually converged to a ratio of 50% heads and 50% tails. Turner argues that a difference of 10 heads in a series of 18 tosses is noticeable but that this difference becomes increasingly negligible with repeated tosses. After a million tosses, a difference of 10 is so small as to be meaningless. But is this explanation accurate and valid? Referring to Hayes' (1969) textbook, the concept of regression has strong roots in the work of Francis Galton. Galton noted that in the prediction of natural characteristics there was an apparent movement to the value of the group average. For example, tall parents were predicted to have children of smaller height while short parents were expected to have taller children. Consistent with the linear prediction rule, it is best-bet practice to predict that an individual will show a tendency to converge to the group average (regression to the mean) on any variable chosen. If this were not the case, we would find a gradual separation of humanity into two classes over generations as the trend continued for the tall to become taller and the short, very short. Regression to the mean is not an invariable phenomenon because exceptions to the rule are possible, tall parents can have taller children. But stated simply in statistical terms, for a value of any standard score Zx, the best linear prediction of the standard score Zy is one relatively nearer the mean of zero than is Zx (Hayes, 1969, p.500).

In my musings, I wondered whether the concept of regression to the mean could be validly applied to categorical random events such as coin tossing, as well as continuous data. Perhaps the phenomenon of equal probabilities for a heads/tails coin toss, I thought in this instance, was best explained by recourse to other statistical laws. By chance, I had recently re-read Wykes (1964) interesting description of the history of gambling. Contained within its pages was an attempt to set the reader on the right path to understand why the ratio of heads to tails in coin tossing approximates 50%. Alan Wykes explains that the popular view held is that in a series of tosses heads must eventually come up because of the *law of averages*. However, he goes on to state that the phrase ' law of averages' is incorrectly used and in this context is meaningless. What is really meant is the *law of large numbers* which states that all cases will happen an equal number of times as the number of tosses approaches *infinity*. In a single toss, the probability of a head is 50%. In the next toss, the probability remains 50%. The preceding outcome has no influence given that these tosses are mutually independent events. In a short series of tosses, it is common for a disproportionate run of outcomes, say heads, to occur. This is interpreted as the lucky streak by the gambler. But, as the number of tosses approach infinity, the outcome reveals a 50% probability.

While the end result is similar, the statistical principles underlying the phenomena of the law of large numbers and the concept of regression to the mean differ.

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Response to 'On Random Musings'

Regression to the mean is actually a product of the law of large numbers, so there is no real contradiction. Regression to the mean in no case requires that the regression will happen. In fact, if you follow numbers along, then sometimes the percentage of heads and tails deviate further from 50%, but over the long term will gradually regress towards 50%. I suppose that to be precise, the law of large numbers is the principle that explains best what is happening in this situation of the number of coins, and regressing towards the mean describes what the percentage is doing —that is getting closer to 50%. Call it what you will, I argue that it is the experience of this phenomenon, that after such extreme deviations from chance as losing streaks, that subsequent experience will be more like the norm and give the person the illusion that the numbers are correcting themselves to conform to the expected average. Many gamblers call this the law of averages. I call it regression because it is a regression of the average in one instance or gambling session to another that produces this illusion. Yes, it is in fact the law of large numbers operating, with a subsequent sample that is more like the norm, but it is most likely still a small sample of gambling experiences.

The use of regression in Galton's example of the height of different people is also an instance of this phenomenon. Height is partly determined by chance and it is the presence of the random component that produces regression over time. If an individual's score is close to an extreme, the potential range of random deviation is constrained by the maximum possible range so that the score will most likely move towards the middle. People in the middle of the distribution can have children that are either taller or shorter and thus the population's height remains stable; the number of tall people that have shorter children is matched by the number of shorter people that have taller children. Note in fact that Galton's example only really works if there is some degree of random breeding. Since height is largely determined by genes and nutrition, you can remove the random component almost completely by proper nutrition and selective breeding. Great Danes, for example, usually have offspring that are very similar to their parents, and do not regress towards the height of the average dog. However, if variation still exists amongst Great Danes they will regress towards the Great Dane mean. A Great Dane is a tall dog because its ancestors were selected for their height, not because of random chance. If random dog breeding were allowed, the Great Dane offspring would on average be smaller because most other breeds are smaller.

The following table outlines the parallel between the height example and gambling sessions to illustrate why I use the term regression to the mean to describe the experience of what happens to people.

Generation 1 Tall Man (e.g., 6 ' 8")	Random Mating →	Generation 2 Shorter Son but still tall (e.g., 6' 3")
Gambling Session one Long Losing Streak	Random Drift →	Gambling Session two Normal number of wins and losses

In the case of height, it is the random breeding that produces an offspring that is more average. In the case of gambling sessions after an unusual session of wins or losses, it is the random wins and losses that produce a session that is more like the expected average. Of course, by chance the offspring could be as tall or taller than the parents, and by chance you could have two winning or two losing sessions in a row. But if chance is operating, the most likely outcome is that extreme events will be followed by less extreme events. And I argue that it is the experience of having a great losing streak (or winning streak) followed by a more average session that produces the illusion of correction.

As for controversy, I think there is more controversy than you think. I've talked to numerous people who believe that solving problem gambling is about helping people deal with underlying issues, rather than their experiences and beliefs. While underlying issues are extremely important, I think we need to understand the beliefs and where they come from in order to solve and prevent problems.

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