Fooled By Randomness

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LOSER TAKES ALL—ON THE NONLINEARITIES OF LIFE

The nonlinear viciousness of life. Moving to Bel Air and acquiring the vices of the rich and famous. Why Microsoft's Bill Gates may not be the best in his business (but please do not inform him of such a fact). Depriving donkeys of food.

Next I put the platitude life is unfair under some examination, but from a new angle. The twist: Life is unfair in a nonlinear way. This chapter is about how a small advantage in life can translate into a highly disproportionate payoff, or, more viciously, how no advantage at all, but a very, very small help from randomness, can lead to a bonanza.

THE SANDPILE EFFECT

First we define nonlinearity. There are many ways to present it, but one of the most popular ones in science is what is called the sand-pile effect, which I can illustrate as follows. I am currently sitting on a beach in Copacabana, in Rio de Janeiro, attempting to do nothing strenuous, away from anything to read and write (unsuccessfully, of course, as I am mentally writing these lines). I am playing with plastic beach toys borrowed from a child, trying to build an edifice—modestly but doggedly attempting to emulate the Tower of Babel. I continuously add sand to the top, slowly raising the entire structure. My Babylonian relatives thought they could thus reach the heavens. I have more humble designs—to test how high I can go before it topples. I keep adding sand, testing to see how the structure will ultimately collapse. Unused to seeing adults build sandcastles, a child looks at me with amazement.

In time—and much to the onlooking child's delight—my castle inevitably topples to rejoin the rest of the sand on the beach. It could be said that the last grain of sand is responsible for the destruction of the entire structure. What we are witnessing here is a nonlinear effect resulting from a linear force exerted on an object. A very small additional input, here the grain of sand, caused a disproportionate result, namely the destruction of my starter Tower of Babel. Popular wisdom has integrated many such phenomena, as witnessed by such expressions as "the straw that broke the camel's back" or "the drop that caused the water to spill."

These nonlinear dynamics have a bookstore name, "chaos theory," which is a misnomer because it has nothing to do with chaos. Chaos theory concerns itself primarily with functions in which a small input can lead to a disproportionate response. Population models, for instance, can lead to a path of explosive growth, or extinction of a species, depending on a very small difference in the population at a starting point in time. Another popular scientific analogy is the weather, where it has been shown that a simple butterfly fluttering its wings in India can cause a hurricane in New York. But the classics have their share to offer as well: Pascal (he of the wager in Chapter 7) said that if Cleopatra's nose had been slightly shorter, the world's fate would have changed. Cleopatra had comely features dominated by a thin and elongated nose that made Julius Caesar and his successor, Marc Antony, fall for her (here the intellectual snob in me cannot resist dissenting against conventional wisdom; Plutarch claimed that it was Cleopatra's skills in conversation, rather than her good looks, that caused the maddening infatuation of the shakers and movers of her day; I truly believe it).

Enter Randomness

Things can become more interesting when randomness enters the game. Imagine a waiting room full of actors queuing for an audition. The number of actors who will win is clearly small, and they are the ones generally observed by the public as representative of the profession, as we saw in our discussion on survivorship bias. The winners would move into Bel Air, feel pressure to acquire some basic training in the consumption of luxury goods, and, perhaps owing to the dissolute and unrhythmic lifestyle, flirt with substance abuse. As to the others (the great majority), we can imagine their fate; a lifetime of serving foamed caffe latte at the neighboring Starbucks, fighting the biological clock between auditions.

One may argue that the actor who lands the lead role that catapults him into fame and expensive swimming pools has some skills others lack, some charm, or a specific physical trait that is a perfect match for such a career path. I beg to differ. The winner may have some acting skills, but so do all of the others, otherwise they would not be in the waiting room.

It is an interesting attribute of fame that it has its own dynamics. An actor becomes known by some parts of the public because he is known by other parts of the public. The dynamics of such fame follow a rotating helix, which may have started at the audition, as the selection could have been caused by some silly detail that fitted the mood of the examiner on that day. Had the examiner not fallen in love the previous day with a person with a similar-sounding last name, then our selected actor from that particular sample history would be serving caffe latte in the intervening sample history.

Learning to Type

Researchers frequently use the example of QWERTY to describe the vicious dynamics of winning and losing in an economy, and to illustrate how the final outcome is more than frequently the undeserved one. The arrangement of the letters on a typewriter is an example of the success of the least deserving method. For our typewriters have the order of the letters on their keyboard arranged in a nonoptimal manner, as a matter of fact in such a nonoptimal manner as to slow down the typing rather than make the job easy, in order to avoid jamming the ribbons as they were designed for less electronic days. Therefore, as we started building better typewriters and computerized word processors, several attempts were made to rationalize the computer keyboard, to no avail. People were trained on a QWERTY keyboard and their habits were too sticky for change. Just like the helical propulsion of an actor into stardom, people patronize what other people like to do. Forcing rational dynamics on the process would be superfluous, nay, impossible. This is called a path dependent outcome, and has thwarted many mathematical attempts at modeling behavior.

It is obvious that the information age, by homogenizing our tastes, is causing the unfairness to be even more acute—those who win capture almost all the customers. The example that strikes many as the most spectacular lucky success is that of the software maker Microsoft and its moody founder Bill Gates. While it is hard to deny that Gates is a man of high personal standards, work ethics, and above-average intelligence, is he the best? Does he deserve it? Clearly not. Most people are equipped with his software (like myself) because other people are equipped with his software, a purely circular effect (economists call that "network externalities"). Nobody ever claimed that it was the best software product. Most of Gates' rivals have an obsessive jealousy of his success. They are maddened by the fact that he managed to win so big while many of them are struggling to make their companies survive.

Such ideas go against classical economic models, in which results either come from a precise reason (there is no account for uncertainty) or the good guy wins (the good guy is the one who is more skilled and has some technical superiority). Economists discovered path-dependent effects late in their game, then tried to publish wholesale on the topic that otherwise would be bland and obvious. For instance, Brian Arthur, an economist concerned with nonlinearities at the Santa Fe Institute, wrote that chance events coupled with positive feedback rather than technological superiority will determine economic superiority—not some abstrusely defined edge in a given area of expertise. While early economic models excluded randomness, Arthur explained how "unexpected orders, chance meetings with lawyers, managerial whims . . . would help determine which ones achieved early sales and, over time, which firms dominated."

MATHEMATICS INSIDE AND OUTSIDE THE REAL WORLD

A mathematical approach to the problem is in order. While in conventional models (such as the well-known Brownian random walk used in finance) the probability of success does not change with every incremental step, only the accumulated wealth, Arthur suggests models such as the Polya process, which is mathematically very difficult to work with, but can be easily understood with the aid of a Monte Carlo simulator. The Polya process can be presented as follows: Assume an urn initially containing equal quantities of black and red balls. You are to guess each time which color you will pull out before you make the draw. Here the game is rigged. Unlike a conventional urn, the probability of guessing correctly depends on past success, as you get better or worse at guessing depending on past performance. Thus, the probability of winning increases after past wins, that of losing increases after past losses. Simulating such a process, one can see a huge variance of outcomes, with astonishing successes and a large number of failures (what we called skewness).

Compare such a process with those that are more commonly modeled, that is, an urn from which the player makes guesses with replacement. Say you played roulette and won. Would this increase your chances of winning again? No. In a Polya process case, it does. Why is this so mathematically hard to work with? Because the notion of independence (i.e., when the next draw does not depend on past outcomes) is violated. Independence is a requirement for working with the (known) math of probability.

What has gone wrong with the development of economics as a science? Answer: There was a bunch of intelligent people who felt compelled to use mathematics just to tell themselves that they were rigorous in their thinking, that theirs was a science. Someone in a great rush decided to introduce mathematical modeling techniques (culprits: Leon Walras, Gerard Debreu, Paul Samuelson) without considering the fact that either the class of mathematics they were using was too restrictive for the class of problems they were dealing with, or that perhaps they should be aware that the precision of the language of mathematics could lead people to believe that they had solutions when in fact they had none (recall Popper and the costs of taking science too seriously). Indeed the mathematics they dealt with did not work in the real world, possibly because we needed richer classes of processes—and they refused to accept the fact that no mathematics at all was probably better.

The so-called complexity theorists came to the rescue. Much excitement was generated by the works of scientists who specialized in nonlinear quantitative methods—the mecca of those being the Santa Fe Institute near Santa Fe, New Mexico. Clearly these scientists are trying hard, and providing us with wonderful solutions in the physical sciences and better models in the social siblings (though nothing satisfactory there yet). And if they ultimately do not succeed, it will simply be because mathematics may be of only secondary help in our real world. Note another advantage of Monte Carlo simulations is that we can get results where mathematics fails us and can be of no help. In freeing us from equations it frees us from the traps of inferior mathematics. As I said in Chapter 3, mathematics is merely a way of thinking and meditating, little more, in our world of randomness.

The Science of Networks

Studies of the dynamics of networks have mushroomed recently. They became popular with Malcolm Gladwell's book The Tipping Point, in which he shows how some of the behaviors of variables such as epidemics spread extremely fast beyond some unspecified critical level. (Like, say, the use of sneakers by inner-city kids or the diffusion of religious ideas. Book sales witness a similar effect, exploding once they cross a significant level of word-of-mouth.) Why do some ideologies or religions spread like wildfire while others become rapidly extinct? How do fads catch fire? How do idea viruses proliferate? Once one exits the conventional models of randomness (the bell curve family of charted randomness), something acute can happen. Why does the Internet hub Google get so many hits as compared to that of the National Association of Retired Veteran Chemical Engineers? The more connected a network, the higher the probability of someone hitting it and the more connected it will be, especially if there is no meaningful limitation on such capacity. Note that it is sometimes foolish to look for precise "critical points" as they may be unstable and impossible to know except, like many things, after the fact. Are these "critical points" not quite points but progressions (the so-called Pareto power laws)? While it is clear that the world produces clusters it is also sad that these may be too difficult to predict (outside of physics) for us to take their models seriously. Once again the important fact is knowing the existence of these nonlinearities, not trying to model them. The value of the great Benoit Mandelbrot's work lies more in telling us that there is a "wild" type of randomness of which we will never know much (owing to their unstable properties).

Our Brain

Our brain is not cut out for nonlinearities. People think that if, say, two variables are causally linked, then a steady input in one variable should always yield a result in the other one. Our emotional apparatus is designed for linear causality. For instance, you study every day and learn something in proportion to your studies. If you do not feel that you are going anywhere, your emotions will cause you to become demoralized. But reality rarely gives us the privilege of a satisfying linear positive progression: You may study for a year and learn nothing, then, unless you are disheartened by the empty results and give up, something will come to you in a flash. My partner Mark Spitznagel summarizes it as follows: Imagine yourself practicing the piano every day for a long time, barely being able to perform "Chopsticks," then suddenly finding yourself capable of playing Rachmaninov. Owing to this nonlinearity, people cannot comprehend the nature of the rare event. This summarizes why there are routes to success that are nonrandom, but few, very few, people have the mental stamina to follow them. Those who go the extra mile are rewarded. In my profession one may own a security that benefits from lower market prices, but may not react at all until some critical point. Most people give up before the rewards.

Buridan's Donkey or the Good Side of Randomness

Nonlinearity in random outcomes is sometimes used as a tool to break stalemates. Consider the problem of the nonlinear nudge. Imagine a donkey equally hungry and thirsty placed at exactly equal distance from sources of food and water. In such a framework, he would die of both thirst and hunger as he would be unable to decide which one to get to first. Now inject some randomness in the picture, by randomly nudging the donkey, causing him to get closer to one source, no matter which, and accordingly away from the other. The impasse would be instantly broken and our happy donkey will be either in turn well fed then well hydrated, or well hydrated then well fed.

The reader no doubt has played a version of Buridan's donkey, by "flipping a coin" to break some of the minor stalemates in life where one lets randomness help with the decision process. Let Lady Fortuna make the decision and gladly submit. I often use Buridan's donkey (under its mathematical name) when my computer goes into a freeze between two possibilities (to be technical, these "randomizations" are frequently done during optimization problems, when one needs to perturbate a function).

Note that Buridan's donkey was named after the fourteenth-century philosopher Jean Buridan. Buridan had an interesting death (he was thrown in the Seine tied in a bag and died drowning). This tale was considered an example of sophistry by his contemporaries who missed the import of randomization—Buridan was clearly ahead of his time.

WHEN IT RAINS, IT POURS

As I am writing these lines, I am suddenly realizing that the world's bipolarity is hitting me very hard. Either one succeeds wildly, by attracting all the cash, or fails to draw a single penny. Likewise with books. Either everyone wants to publish it, or nobody is interested in returning telephone calls (in the latter case my discipline is to delete the name from my address book). I am also realizing the nonlinear effect behind success in anything: It is better to have a handful of enthusiastic advocates than hordes of people who appreciate your work—better to be loved by a dozen than liked by the hundreds. This applies to the sales of books, the spread of ideas, and success in general and runs counter to conventional logic. The information age is worsening this effect. This is making me, with my profound and antiquated Mediterranean sense of metron (measure), extremely uncomfortable, even queasy. Too much success is the enemy (think of the punishment meted out on the rich and famous); too much failure is demoralizing. I would like the option of having neither.