

TO 1200: BEGINNINGS

COPYRIGHTED MATERIAL

1

The Winds of the Greeks and the Role of the Dice

Why is the mastery of risk such a uniquely modern concept? Why did humanity wait the many thousands of years leading up to the Renaissance before breaking down the barriers that stood in the way of measuring and controlling risk?

These questions defy easy answers. But we begin with a clue. Since the beginning of recorded history, gambling—the very essence of risk-taking—has been a popular pastime and often an addiction. It was a game of chance that inspired Pascal and Fermat’s revolutionary breakthrough into the laws of probability, not some profound question about the nature of capitalism or visions of the future. Yet until that moment, throughout history, people had wagered and played games without using any system of odds that determines winnings and losings today. The act of risk-taking floated free, untrammelled by the theory of risk management.

Human beings have always been infatuated with gambling because it puts us head-to-head against the fates, with no holds barred. We enter this daunting battle because we are convinced that we have a powerful ally: Lady Luck will interpose herself between us and the fates

(or the odds) to bring victory to our side. Adam Smith, a masterful student of human nature, defined the motivation: “The overweening conceit which the greater part of men have of their own abilities [and] their absurd presumption in their own good fortune.”¹ Although Smith was keenly aware that the human propensity to take risk propelled economic progress, he feared that society would suffer when that propensity ran amuck. So he was careful to balance moral sentiments against the benefits of a free market. A hundred and sixty years later, another great English economist, John Maynard Keynes, agreed: “When the capital development of a country becomes the by-product of the activities of a casino, the job is likely to be ill-done.”²

Yet the world would be a dull place if people lacked conceit and confidence in their own good fortune. Keynes had to admit that “If human nature felt no temptation to take a chance . . . there might not be much investment merely as a result of cold calculation.”³ Nobody takes a risk in the expectation that it will fail. When the Soviets tried to administer uncertainty out of existence through government fiat and planning, they choked off social and economic progress.



Gambling has held human beings in thrall for millennia. It has been engaged in everywhere, from the dregs of society to the most respectable circles.

Pontius Pilate’s soldiers cast lots for Christ’s robe as He suffered on the cross. The Roman Emperor Marcus Aurelius was regularly accompanied by his personal croupier. The Earl of Sandwich invented the snack that bears his name so that he could avoid leaving the gaming table in order to eat. George Washington hosted games in his tent during the American Revolution.⁴ Gambling is synonymous with the Wild West. And “Luck Be a Lady Tonight” is one of the most memorable numbers in *Guys and Dolls*, a musical about a compulsive gambler and his floating crap game.

The earliest-known form of gambling was a kind of dice game played with what was known as an astragalus, or knuckle-bone.⁵ This early ancestor of today’s dice was a squarish bone taken from the ankles of sheep or deer, solid and without marrow, and so hard as to be virtually indestructible. Astragali have surfaced in archeological digs in many

parts of the world. Egyptian tomb paintings picture games played with astragali dating from 3500 BC, and Greek vases show young men tossing the bones into a circle. Although Egypt punished compulsive gamblers by forcing them to hone stones for the pyramids, excavations show that the pharaohs were not above using loaded dice in their own games. Craps, an American invention, derives from various dice games brought into Europe via the Crusades. Those games were generally referred to as “hazard,” from *al zahr*, the Arabic word for dice.⁶

Card games developed in Asia from ancient forms of fortunetelling, but they did not become popular in Europe until the invention of printing. Cards originally were large and square, with no identifying figures or pips in the corners. Court cards were printed with only one head instead of double-headed, which meant that players often had to identify them from the feet—turning the cards around would reveal a holding of court cards. Square corners made cheating easy for players who could turn down a tiny part of the corner to identify cards in the deck later on. Double-headed court cards and cards with rounded corners came into use only in the nineteenth century.

Like craps, poker is an American variation on an older form—the game is only about 150 years old. David Hayano has described poker as “Secret ploys, monumental deceptions, calculated strategies, and fervent beliefs [with] deep, invisible structures. . . . A game to experience rather than to observe.”⁷ According to Hayano, about forty million Americans play poker regularly, all confident of their ability to outwit their opponents.

The most addictive forms of gambling seem to be the pure games of chance played at the casinos that are now spreading like wildfire through once staid American communities. An article in *The New York Times* of September 25, 1995, datelined Davenport, Iowa, reports that gambling is the fastest-growing industry in the United States, “a \$40 billion business that draws more customers than baseball parks or movie theaters.”⁸ The *Times* cites a University of Illinois professor who estimates that state governments pay three dollars in costs to social agencies and the criminal justice system for every dollar of revenue they take in from the casinos—a calculus that Adam Smith might have predicted.

Iowa, for example, which did not even have a lottery until 1985, had ten big casinos by 1995, plus a horse track and a dog track with 24-hour slot machines. The article states that “nearly nine out of ten

Iowans say they gamble,” with 5.4% of them reporting that they have a gambling problem, up from 1.7% five years earlier. This in a state where a Catholic priest went to jail in the 1970s on charges of running a bingo game. *AI zahr* in its purest form is apparently still with us.



Games of chance must be distinguished from games in which skill makes a difference. The principles at work in roulette, dice, and slot machines are identical, but they explain only part of what is involved in poker, betting on the horses, and backgammon. With one group of games the outcome is determined by fate; with the other group, choice comes into play. The odds—the probability of winning—are all you need to know for betting in a game of chance, but you need far more information to predict who will win and who will lose when the outcome depends on skill as well as luck. There are cardplayers and racetrack bettors who are genuine professionals, but no one makes a successful profession out of shooting craps.

Many observers consider the stock market itself little more than a gambling casino. Is winning in the stock market the result of skill combined with luck, or is it just the result of a lucky gamble? We shall return to this question in Chapter 12.

Losing streaks and winning streaks occur frequently in games of chance, as they do in real life. Gamblers respond to these events in asymmetric fashion: they appeal to the law of averages to bring losing streaks to a speedy end. And they appeal to that same law of averages to suspend itself so that winning streaks will go on and on. The law of averages hears neither appeal. The last sequence of throws of the dice conveys absolutely no information about what the next throw will bring. Cards, coins, dice, and roulette wheels have no memory.

Gamblers may think they are betting on red or seven or four-of-a-kind, but *in reality they are betting on the clock*. The loser wants a short run to look like a long run, so that the odds will prevail. The winner wants a long run to look like a short run, so that the odds will be suspended. Far away from the gaming tables, the managers of insurance companies conduct their affairs in the same fashion. They set their premiums to cover the losses they will sustain in the long run; but when earthquakes

and fires and hurricanes all happen at about the same time, the short run can be very painful. Unlike gamblers, insurance companies carry capital and put aside reserves to tide them over during the inevitable sequences of short runs of bad luck.

Time is the dominant factor in gambling. Risk and time are opposite sides of the same coin, for if there were no tomorrow there would be no risk. Time transforms risk, and the nature of risk is shaped by the time horizon: the future is the playing field.

Time matters most when decisions are irreversible. And yet many irreversible decisions must be made on the basis of incomplete information. Irreversibility dominates decisions ranging all the way from taking the subway instead of a taxi, to building an automobile factory in Brazil, to changing jobs, to declaring war.

If we buy a stock today, we can always sell it tomorrow. But what do we do after the croupier at the roulette table cries, "No more bets!" or after a poker bet is doubled? There is no going back. Should we refrain from acting in the hope that the passage of time will make luck or the probabilities turn in our favor?

Hamlet complained that too much hesitation in the face of uncertain outcomes is bad because "the native hue of resolution is sicklied o'er with the pale cast of thought . . . and enterprises of great pith and moment . . . lose the name of action." Yet once we act, we forfeit the option of waiting until new information comes along. As a result, not-acting has value. The more uncertain the outcome, the greater may be the value of procrastination. Hamlet had it wrong: he who hesitates is halfway home.



To explain the beginning of everything, Greek mythology drew on a giant game of craps to explain what modern scientists call the Big Bang. Three brothers rolled dice for the universe, with Zeus winning the heavens, Poseidon the seas, and Hades, the loser, going to hell as master of the underworld.

Probability theory seems a subject made to order for the Greeks, given their zest for gambling, their skill as mathematicians, their mastery of logic, and their obsession with proof. Yet, though the most civilized

of all the ancients, they never ventured into that fascinating world. Their failure to do so is astonishing because the Greeks had the only recorded civilization up to that point untrammelled by a dominating priesthood that claimed a monopoly on the lines of communication with the powers of mystery. Civilization as we know it might have progressed at a much faster pace if the Greeks had anticipated what their intellectual progeny—the men of the Renaissance—were to discover some thousand years later.

Despite the emphasis that the Greeks placed on theory, they had little interest in applying it to any kind of technology that would have changed their views of the manageability of the future. When Archimedes invented the lever, he claimed that he could move the earth if only he could find a place to stand. But apparently he gave no thought to changing it. The daily life of the Greeks, and their standard of living, were much the same as the way that their forebears had subsisted for thousands of years. They hunted, fished, grew crops, bore children, and used architectural techniques that were only variations on themes developed much earlier in the Tigris-Euphrates valley and in Egypt.

Genuflection before the winds was the only form of risk management that caught their attention: their poets and dramatists sing repeatedly of their dependence on the winds, and beloved children were sacrificed to appease the winds. Most important, the Greeks lacked a numbering system that would have enabled them to *calculate* instead of just recording the results of their activities.⁹

I do not mean to suggest that the Greeks gave no thought to the nature of probability. The ancient Greek word *εἰκος* (*eikos*), which meant plausible or probable, had the same sense as the modern concept of probability: “to be expected with some degree of certainty.” Socrates defines *εἰκος* as “likeness to truth.”¹⁰

Socrates’ definition reveals a subtle point of great importance. *Likeness to truth is not the same thing as truth.* Truth to the Greeks was only what could be proved by logic and axioms. Their insistence on proof set truth in direct contrast to empirical experimentation. For example, in *Phaedo*, Simmias points out to Socrates that “the proposition that the soul is in harmony has not been demonstrated at all but rests only on probability.” Aristotle complains about philosophers who, “. . . while they speak plausibly, . . . do not speak what is true.” Elsewhere, Socrates

anticipates Aristotle when he declares that a “mathematician who argues from probabilities in geometry is not worth an ace.”¹¹ For another thousand years, *thinking* about games and *playing* them remained separate activities.

Shmuel Sambursky, a distinguished Israeli historian and philosopher of science, provides the only convincing thesis I could find to explain why the Greeks failed to take the strategic step of developing a quantitative approach to probability.¹² With their sharp distinction between truth and probability, Sambursky contends in a paper written in 1956, the Greeks could not conceive of any kind of solid structure or harmony in the messy nature of day-to-day existence. Although Aristotle suggested that people should make decisions on the basis of “desire and reasoning directed to some end,” he offered no guidance to the likelihood of a successful outcome. Greek dramas tell tale after tale of the helplessness of human beings in the grasp of impersonal fates. When the Greeks wanted a prediction of what tomorrow might bring, they turned to the oracles instead of consulting their wisest philosophers.

The Greeks believed that order is to be found only in the skies, where the planets and stars regularly appear in their appointed places with an unmatched regularity. To this harmonious performance, the Greeks paid deep respect, and their mathematicians studied it intensely. But the perfection of the heavens served only to highlight the disarray of life on earth. Moreover, the predictability of the firmament contrasted sharply with the behavior of the fickle, foolish gods who dwelt on high.

The old Talmudic Jewish philosophers may have come a bit closer to quantifying risk. But here, too, we find no indication that they followed up on their reasoning by developing a methodical approach to risk. Sambursky cites a passage in the Talmud, *Kethuboth 9q*, where the philosopher explains that a man may divorce his wife for adultery without any penalty, but not if he claims that the adultery occurred before marriage.¹³

“It is a double doubt,” declares the Talmud. If it is established (method unspecified) that the bride came to the marriage bed no longer a virgin, one side of the double doubt is whether the man responsible was the prospective groom himself—whether the event occurred “under him . . . or not under him.” As to the second side of the doubt, the argument continues: “And if you say that it was under him, there

is doubt whether it was by violence or by her free will.” Each side of the double doubt is given a 50–50 chance. With impressive statistical sophistication, the philosophers conclude that there is only one chance in four ($1/2 \times 1/2$) that the woman committed adultery before marriage. Therefore, the husband cannot divorce her on those grounds.



One is tempted to assume that the lapse of time between the invention of the astragalus and the invention of the laws of probability was nothing more than a historical accident. The Greeks and the Talmudic scholars were so maddeningly close to the analysis that Pascal and Fermat would undertake centuries later that only a slight push would have moved them on to the next step.

That the push did not occur was not an accident. Before a society could incorporate the concept of risk into its culture, change would have to come, not in views of the present, but in attitudes about the future.

Up to the time of the Renaissance, people perceived the future as little more than a matter of luck or the result of random variations, and most of their decisions were driven by instinct. When the conditions of life are so closely linked to nature, not much is left to human control. As long as the demands of survival limit people to the basic functions of bearing children, growing crops, hunting, fishing, and providing shelter, they are simply unable to conceive of circumstances in which they might be able to influence the outcomes of their decisions. A penny saved is not a penny earned unless the future is something more than a black hole.

Over the centuries, at least until the Crusades, most people met with few surprises as they ambled along from day to day. Nestled in a stable social structure, they gave little heed to the wars that swept across the land, to the occasions when bad rulers succeeded good ones, and even to the permutations of religions. Weather was the most apparent variable. As the Egyptologist Henri Frankfort has remarked, “The past and the future—far from being a matter of concern—were wholly implicit in the present.”¹⁴

Despite the persistence of this attitude toward the future, civilization made great strides over the centuries. Clearly the absence of modern views about risk was no obstacle. At the same time, the advance of

civilization was not in itself a sufficient condition to motivate curious people to explore the possibilities of scientific forecasting.



As Christianity spread across the western world, the will of a single God emerged as the orienting guide to the future, replacing the miscellany of deities people had worshiped since the beginning of time. This brought a major shift in perception: the future of life on earth remained a mystery, but it was now prescribed by a power whose intentions and standards were clear to all who took the time to learn them.

As contemplation of the future became a matter of moral behavior and faith, the future no longer appeared quite as inscrutable as it had. Nevertheless, it was still not susceptible to any sort of mathematical expectation. The early Christians limited their prophecies to what would happen in the afterlife, no matter how fervently they beseeched God to influence worldly events in their favor.

Yet the search for a better life on earth persisted. By the year 1000, Christians were sailing great distances, meeting new peoples, and encountering new ideas. Then came the Crusades—a seismic culture shock. Westerners collided with an Arab empire that had been launched at Mohammed's urging and that stretched as far eastward as India. Christians, with faith in the future, met Arabs who had achieved an intellectual sophistication far greater than that of the interlopers who had come to dislodge them from the holy sites.

The Arabs, through their invasion of India, had become familiar with the Hindu numbering system, which enabled them to incorporate eastern intellectual advances into their own scholarship, scientific research, and experimentation. The results were momentous, first for the Arabs and then for the West.*

In the hands of the Arabs, the Hindu numbers would transform mathematics and measurement in astronomy, navigation, and commerce. New methods of calculation gradually replaced the abacus,

*Peter Kinder has pointed out to me a great historical irony in all this. The Vikings and other Norsemen who laid waste to Roman civilization and destroyed the repositories of learning in the ninth century reappear in history as the Normans who brought back to the West the achievements of Arabic learning in the twelfth century.

which for centuries had been the only tool for doing arithmetic everywhere from the Mayans in the western hemisphere, across Europe, to India and the Orient. The word *abacus* derives from the Greek word *abax*, which means sand-tray. Within the trays, columns of pebbles were laid out on the sand.¹⁵ The word *calculate* stems from *calculus*, the Latin word for pebble.

Over the next five hundred years, as the new numbering system took the place of the simple abacus, writing replaced movable counters in making calculations. Written computation fostered abstract thinking, which opened the way to areas of mathematics never conceived of in the past. Now sea voyages could be longer, time-keeping more accurate, architecture more ambitious, and production methods more elaborate. The modern world would be quite different if we still measured and counted with I, V, X, L, C, D, and M—or with the Greek or Hebrew letters that stood for numbers.

But Arabic numbers were not enough to induce Europeans to explore the radical concept of replacing randomness with systematic probability and its implicit suggestion that the future might be predictable and even controllable to some degree. That advance had to await the realization that human beings are not totally helpless in the hands of fate, nor is their worldly destiny always determined by God.

The Renaissance and the Protestant Reformation would set the scene for the mastery of risk. As mysticism yielded to science and logic after 1300 AD, Greek and Roman architectural forms began to replace Gothic forms, church windows were opened to the light, and sculptures showed men and women standing firmly on the ground instead posing as stylized figures with neither muscle nor weight. The ideas that propelled changes in the arts also contributed to the Protestant Reformation and weakened the dominance of the Catholic Church.

The Reformation meant more than just a change in humanity's relationship with God. By eliminating the confessional, it warned people that henceforth they would have to walk on their own two feet and would have to take responsibility for the consequences of their decisions.

But if men and women were not at the mercy of impersonal deities and random chance, they could no longer remain passive in the face of an unknown future. They had no choice but to begin making decisions over a far wider range of circumstances and over far longer periods of

time than ever before. The concepts of thrift and abstinence that characterize the Protestant ethic evidenced the growing importance of the future relative to the present. With this opening up of choices and decisions, people gradually recognized that the future offered opportunity as well as danger, that it was open-ended and full of promise. The 1500s and 1600s were a time of geographical exploration, confrontation with new lands and new societies, and experimentation in art, poetic forms, science, architecture, and mathematics. The new sense of opportunity led to a dramatic acceleration in the growth of trade and commerce, which served as a powerful stimulus to change and exploration. Columbus was not conducting a Caribbean cruise: he was seeking a new trade route to the Indies. The prospect of getting rich is highly motivating, and few people get rich without taking a gamble.

There is more to that blunt statement than meets the eye. Trade is a mutually beneficial process, a transaction in which both parties perceive themselves as wealthier than they were before. What a radical idea! Up to that point, people who got rich had done so largely by exploitation or by plundering another's wealth. Although Europeans continued to plunder across the seas, at home the accumulation of wealth was open to the many rather than the few. The newly rich were now the smart, the adventuresome, the innovators—most of them businessmen—instead of just the hereditary princes and their minions.

Trade is also a risky business. As the growth of trade transformed the principles of gambling into the creation of wealth, the inevitable result was capitalism, the epitome of risk-taking. But capitalism could not have flourished without two new activities that had been unnecessary so long as the future was a matter of chance or of God's will. The first was bookkeeping, a humble activity but one that encouraged the dissemination of the new techniques of numbering and counting. The other was forecasting, a much less humble and far more challenging activity that links risk-taking with direct payoffs.

You do not plan to ship goods across the ocean, or to assemble merchandise for sale, or to borrow money without first trying to determine what the future may hold in store. Ensuring that the materials you order are delivered on time, seeing to it that the items you plan to sell are produced on schedule, and getting your sales facilities in place all must be planned before that moment when the customers show up and

lay their money on the counter. The successful business executive is a forecaster first; purchasing, producing, marketing, pricing, and organizing all follow.



The men you will meet in the coming chapters recognized the discoveries of Pascal and Fermat as the beginning of wisdom, not just a solution to an intellectual conundrum involving a game of chance. They were bold enough to tackle the many facets of risk in the face of issues of growing complexity and practical importance and to recognize that these are issues involving the most fundamental philosophical aspects of human existence.

But philosophy must stand aside for the moment, as the story should begin at the beginning. Modern methods of dealing with the unknown start with measurement, with odds and probabilities. The numbers come first. But where did the numbers come from?