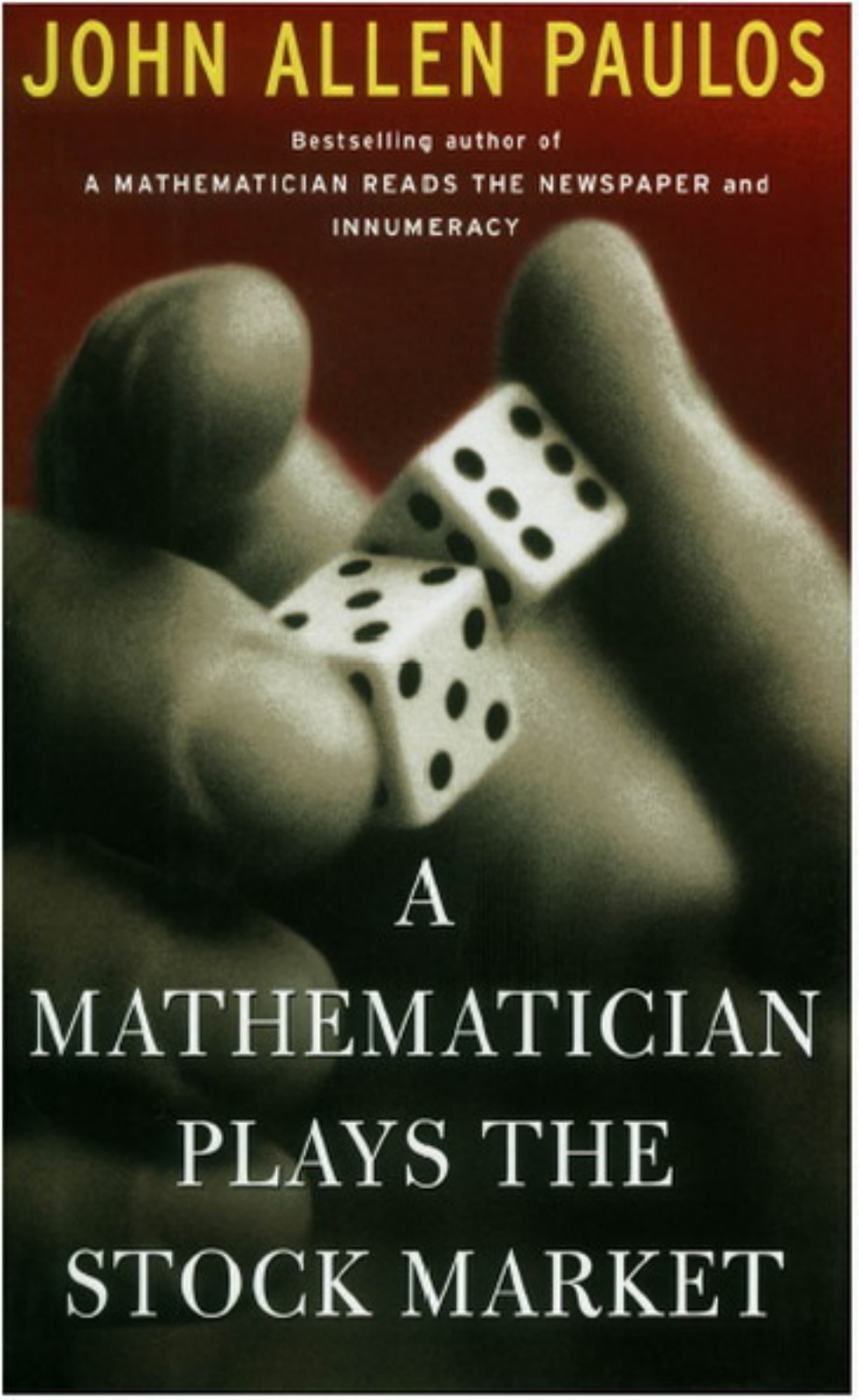
JOHN ALLEN PAULOS

Bestselling author of
A MATHEMATICIAN READS THE NEWSPAPER and
INNUMERACY



A MATHEMATICIAN PLAYS THE STOCK MARKET

Technical Analysis: Following the Followers

My own prejudices aside, the justification for technical analysis is murky at best. To the extent there is one, it most likely derives from psychology, perhaps in part from the Keynesian idea of conventionally anticipating the conventional response, or perhaps from some as yet unarticulated systemic interactions. "Unarticulated" is the key word here: The quasi-mathematical jargon of technical analysis seldom hangs together as a coherent theory. I'll begin my discussion of it with one of its less plausible manifestations, the so-called Elliott wave theory.

Ralph Nelson Elliott famously believed that the market moved in waves that enabled investors to predict the behavior of stocks. Outlining his theory in 1939, Elliott wrote that stock prices move in cycles based upon the Fibonacci numbers (1, 2, 3, 5, 8, 13, 21, 34, 59, 93, . . . , each successive number in the sequence being the sum of the two previous ones). Most commonly the market rises in five distinct waves and declines in three distinct waves for obscure psychological or systemic reasons. Elliott believed as well that these patterns exist at many levels and that any given wave or cycle is part of a larger one and contains within it smaller waves and cycles. (To give Elliott his due, this idea of small waves within larger ones having the same structure does seem to presage mathematician Benoit Mandelbrot's more sophisticated notion of a fractal, to which I'll return later.) Using Fibonacci-inspired rules, the investor buys on rising waves and sells on falling ones.

The problem arises when these investors try to identify where on a wave they find themselves. They must also decide whether the larger or smaller cycle of which the wave is inevitably a part may temporarily be overriding the signal to buy or sell. To save the day, complications are introduced into the theory, so many, in fact, that the theory soon becomes

incapable of being falsified. Such complications and unfalsifiability are reminiscent of the theory of biorhythmns and many other pseudosciences. (Biorhythm theory is the idea that various aspects of one's life follow rigid periodic cycles that begin at birth and are often connected to the numbers 23 and 28, the periods of some alleged male and female principles, respectively.) It also brings to mind the ancient Ptolemaic system of describing the planets' movements, in which more and more corrections and ad hoc exceptions had to be created to make the system jibe with observation. Like most other such schemes, Elliott wave theory founders on the simple question: Why should anyone expect it to work?

For some, of course, what the theory has going for it is the mathematical mysticism associated with the Fibonacci numbers, any two adjacent ones of which are alleged to stand in an aesthetically appealing relation. Natural examples of Fibonacci series include whorls on pine cones and pineapples; the number of leaves, petals, and stems on plants; the numbers of left and right spirals in a sunflower; the number of rabbits in succeeding generations; and, insist Elliott enthusiasts, the waves and cycles in stock prices.

It's always pleasant to align the nitty-gritty activities of the market with the ethereal purity of mathematics.

The Euro and the Golden Ratio

Before moving on to less barren financial theories, I invite you to consider a brand new instance of financial numerology. An email from a British correspondent apprised me of an interesting connection between the euro-pound and pound-euro exchange rates on March 19, 2002.

To appreciate it, one needs to know the definition of the golden ratio from classical Greek mathematics. (Those for

whom the confluence of Greek, mathematics, and finance is a bit much may want to skip to the next section.) If a point on a straight line divides the line so that the ratio of the longer part to the shorter is equal to the ratio of the whole to the longer part, the point is said to divide the line in a golden ratio. Rectangles whose length and width stand in a golden ratio are also said to be golden, and many claim that rectangles of this shape, for example, the facade of the Parthenon, are particularly pleasing to the eye. Note that a 3-by-5 card is almost a golden rectangle since 5/3 (or 1.666 . . .) is approximately equal to (5 + 3)/5 (or 1.6).

The value of the golden ratio, symbolized by the Greek letter phi, is 1.618 . . . (the number is irrational and so its decimal representation never repeats). It is not difficult to prove that phi has the striking property that it is exactly equal to 1 plus its reciprocal (the reciprocal of a number is simply 1 divided by the number). Thus 1.618 . . . is equal to 1 + 1/1.618 . . . .

This odd fact returns us to the euro and the pound. An announcer on the BBC on the day in question, March 19, 2002, observed that the exchange rate for 1 pound sterling was 1 euro and 61.8 cents (1.618 euros) and that, lo and behold, this meant that the reciprocal exchange rate for 1 euro was 61.8 pence (.618 pounds). This constituted, the announcer went on, "a kind of symmetry." The announcer probably didn't realize how profound this symmetry was.

In addition to the aptness of "golden" in this financial context, there is the following well-known relation between the golden ratio and the Fibonacci numbers. The ratio of any Fibonacci number to its predecessor is close to the golden ratio of 1.618 . . . , and the bigger the numbers involved, the closer the two ratios become. Consider again, the Fibonacci numbers, 1, 2, 3, 5, 8, 13, 21, 34, 59, ... The ratios, 5/3, 8/5,

13/8, 21/13, . . . , of successive Fibonacci numbers approach the golden ratio of 1.618 . . . !

There's no telling how an Elliott wave theorist dabbling in currencies at the time of the above exchange rate coincidence would have reacted to this beautiful harmony between money and mathematics. An unscrupulous, but numerate hoaxer might have even cooked up some flapdoodle sufficiently plausible to make money from such a "cosmic" connection.

The story could conceivably form the basis of a movie like *Pi*, since there are countless odd facts about phi that could be used to give various investing schemes a superficial plausibility. (The protagonist of *Pi* was a numerologically obsessed mathematician who thought he'd found the secret to just about everything in the decimal expansion of pi. He was pursued by religious zealots, greedy financiers, and others. The only sane character, his mentor, had a stroke, and the syncopated black-and-white cinematography was anxiety-inducing. Appealing as it was, the movie was mathematically nonsensical.) Unfortunately for investors and mathematicians alike, the lesson again is that more than beautiful harmonies are needed to make money on Wall Street. And *Phi* can't match the cachet of *Pi* as a movie title either.

Moving Averages, Big Picture

People, myself included, sometimes ridicule technical analysis and the charts associated with it in one breath and then in the next reveal how much in (perhaps unconscious) thrall to these ideas they really are. They bring to mind the old joke about the man who complains to his doctor that his wife has for several years believed she's a chicken. He would have sought help sooner, he says, "but we needed the eggs." Without reading