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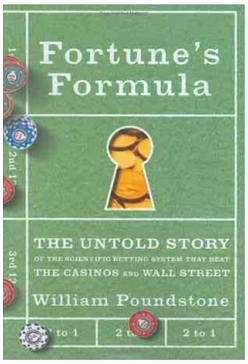

Fortune's Formula

The Untold Story of the Scientific Betting System That Beat the Casinos and Wall Street

by William Poundstone
Hill and Wang © 2005
400 pages

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Take-Aways

- Finance, investing and gambling seem very different, but they all require their practitioners to have the ability to manage uncertainly.
- Claude Shannon, the father of information theory, began the digital communication revolution.
- He worked among the world's best mathematicians at Bell Labs.
- With the Information Theory, he maximized the bandwidth a channel could carry and he preserved the meaning of the data the channel carried.
- Shannon's colleague, Edward Thorp, applied scientific ideas to develop a card counting system for winning at blackjack. He wrote the popular book, *Beat the Dealer,* in 1962.
- Bell's John Kelly created the proportional betting system to avoid "gambler's ruin."
- Thorp and Dean Kassouf created the Princeton-Newport hedge fund.
- In the course of taking a large position in the AT&T breakup, Princeton-Newport executed the largest trade in NYSE history.
- One of the most profitable hedge funds ever, it operated for 19 years.
- Its compound annual return averaged 15% after fees.

Rating (10 is best)

Overall	Applicability	Innovation	Style
9	**7**	**10**	**9**

Relevance

What You Will Learn

In this Abstract, you will learn: 1) How information theory helped shape modern finance; 2) How it also helped gamblers win at roulette and blackjack; and 3) How one of history's most successful hedge funds applied mathematical and gambling concepts to investing.

Recommendation

This is a fascinating book about the sociology of ideas and, specifically, about information theory. Author William Poundstone explores how Claude Shannon, the major developer of information theory, affected finance, investing and gambling. These activities seem disconnected, but they all rely on managing uncertainty. Like any great idea, information theory attracted major personalities: gamblers, mobsters, academics, economists, traders and people who just wanted to make money. The story weaves through a collection of memorable people (from seventeenth-century mathematicians to Ivan Boesky) to present pertinent mathematical and scientific theories, and to explore how people used them. At times, the connections between events seem strained, but they all come together. This book is encyclopedic, exceptionally informative, and packed with great stories and characters. *getAbstract.com* enthusiastically recommends it to anyone seriously interested in investing, the sociology of ideas, or gambling. Indeed, read it twice: once for its theories and practical investment advice, and the other to relish its personalities.

Abstract

Searching for a Sure Thing

"It is the American dream to invent a useful new product or service that makes a fortune."

In 1956, Claude Shannon worked at AT&T's Bell Labs in Orange, New Jersey. The Massachusetts Institute of Technology (MIT) aggressively courted him for its faculty because of his work on information theory, the science behind today's computers, and the field of digital communications. Shannon had the idea of developing the binary code of zeroes and ones to simulate the "on" and "off" positions in electrical circuits. Due to this work, he was one of the inventors credited with building the first computer. Based on a 1948 paper he wrote, Shannon was also known for shaping the ways that information theory contributed to developing the entire digital age. Applied in the real world, his paper led to multiple inventions including cell phones, HDTV, DNA sequencing and fiber optic cable.

Shannon was born in Petoskey, Michigan, in 1918. He picked up his grandfather's interest in investing. Graduating from the University of Michigan in 1936, he happened to see a postcard inviting applicants to work on a new MIT computer, the Differential Analyzer. Shannon met with the computer's inventor, Vannevar Bush, who hired him. The computer, the size of a two-car garage, consisted of electric motors, pulleys and shafts. When Bush wanted to solve a specific problem, he had to set each mechanical function to address that problem. The gear ratios corresponded to certain values. Once configured, the computer would work for several days to solve an equation. The end product was a graph.

"A trader who wants to beat the market must have an edge, a more accurate view of what bets on stocks are really worth."

While setting the machine for various calculations, Shannon saw that it was basically mechanical. He realized that a purely electrical device would be easier to operate, using electrical circuits to represent numbers. Shannon had taken an undergraduate course in Boolean algebra, which relies on "true" and "false" statements with connecting words,

such as "and" or "not." He rigged the computer's circuits to emulate Boolean logic and found that his innovation worked. At age 21, he published his results in his 1937 master's thesis.

"In the twentieth century, the average stock market return was something like 5% more than the risk-free rate."

Shannon worked on a genetics Ph.D., and did research at Bell Labs, an institute in Princeton, and the U.S. Office of Scientific Research and Development (studying gunfire trajectories). He also briefly married and divorced, becoming increasingly reclusive. He accepted a job back at Bell Labs on a top-secret project called SIGSALY, set up to invent the world's first encoded wireless telephone. The plan called for installing the phone in only four locations: the Pentagon (for President Franklin Roosevelt), a British department store (for Winston Churchill), North Africa (for Field Marshal Montgomery) and Guam (for General McArthur).

The phone consisted of a 55-ton computer, an isolation booth and an air conditioner that kept the tubes from melting. The system used a "onetime pad" for encoding. Each user needed the code, and a vinyl record which played "white noise" to mask the user's voice. Each voice could be heard only by using another special vinyl record to eliminate the original "white noise." Each record had to be synchronized and played at the same speed for the message to be intelligible.

"Active investing is, therefore, a zero-sum game."

After the war, Shannon went to Bell Labs, where he published his information theory paper. By 1958, he was an MIT faculty member, though he eventually quit teaching in favor of research. He had an active mind, but rarely completed one investigation before pursuing another. He seldom published, because he insisted that his work had to be perfect. From 1958 to 1974, his research output was nine articles. From 1974 to 1984, he published one article, on juggling (he could juggle four balls). By then, Alzheimer's disease had undermined his abilities.

Spinning the Wheel

In the late 1950s, a grad student named Ed Thorp participated in a party discussion about ways to make easy money. Someone suggested roulette. Thorp noted that if a roulette wheel's alignment was flawed, a gambler could make money because the lack of balance would push the ball to certain sectors of the wheel. But even with a perfect wheel, Thorp said, the law of physics would prevail, making it scientifically possible to predict where the ball would land. Thorp went to Las Vegas in 1958 to test elements of his theory. However, he didn't play roulette. Instead, he played blackjack using a system developed by mathematician Roger Baldwin and three others who worked for the U.S. Army. He determined that the system could work – with additional research.

"One of the puzzles of the market is that stock prices are more volatile than corporate earnings."

The next year, Thorp went to MIT as a math instructor. He used MIT's IBM 704 computer to work on his system, focusing on the number five card and its importance in shifting odds back to the casino. He wanted to submit his paper on this topic to a respected academic journal, but that required having a member of the National Academy of Science agree to review it and submit it. MIT's only Academy member was Claude Shannon.

Shannon liked the Thorp's paper, and was intrigued by his idea of developing a system to beat roulette. They decided to build a "roulette prediction machine." Shannon even spent $1,500 for a professional roulette wheel for their experiments. The men did not want to pick winning numbers, but to narrow the sectors where the ball would land. They learned that a slight tilt of the wheel, even half as thick as a poker chip, altered the results in their favor. They built a small, 12-transistor calculator with a toe-operated switch and an earphone. The idea was to take it to a casino and input real-time betting information. The calculator

"Predictable patterns in the market would allow excess returns."

would emit a tone indicating where the ball would land. With this system, they estimated they could improve their odds enough to beat the house. Despite these elaborate plans, the thin earphone wires broke during the casino test and they abandoned the project.

"The story of the Kelly system is a story of secrets – or if you prefer, a story of entropy."

However, Shannon turned his full attention to devising a mathematical approach to gambling. He realized that serious gamblers optimize their bets based on existing odds and conditions, and that money management is key to long-term success, since all gamblers lose their winnings over time. If a gambler bets the same amount each time, the wins and losses will vary greatly. Shown as a graphic, this jagged chart is called the "random walk." Over time, the frequency of wins and losses widens, thus explaining winning and losing streaks, including wipeouts or "gambler's ruin."

Shannon learned that John Kelly Jr., a Bell Lab voice synthesis scientist, had devised a mathematical gambling system. Kelly, who was interested in information theory, had investigated the importance of inside information (an idea sparked by *The $64,000 Question* scandal in 1955) and how it affected uncertainty (or "entropy" in information theory terms). Applying his inside information concept to blackjack, he devised the Kelly wagering system, which claimed to avoid "gambler's ruin" by using a proportional betting system.

"Through diversification, fractional Kelly position sizes, and a philosophy of erring on the side of caution, Thorp achieved a smooth exponential growth refuting the conventional trade-off of risk and return."

The system scaled bets as percentages of risk capital, so a gambler always had cash in reserve. The underlying idea was that the longer gamblers could remain in the game, the longer they had the opportunity to benefit from the law of large numbers.

Information Theory

Back at Bell Labs, scientists were improving telephone and telegraph lines so they could carry more conversations or messages per line, thus conserving expensive cable. To visualize this problem, imagine a water pipe that can carry only so many gallons per minute. Water cannot be compressed, so the pipe's diameter determines flow capacity. With a cable, the challenge is increasing capacity or bandwidth. That is why telegraph operators dropped unneeded words, letters and punctuation. Bell scientists worked to preserve the clear meaning of compressed messages, but Shannon had a different approach. He described a message's meaning in statistical terms, approached from a probability perspective. Today, cellular phones use Shannon's applications to encode messages and save bandwidth.

"Kelly's prescription can be restated as a simple rule: When faced with a choice of wagers or investments, choose the one with the highest geometric mean of outcomes."

In acknowledgement of contributing work in the 1920s by Bell scientists Ralph Hartley and Harry Nyquist, Shannon called his ideas, "Information Theory." People misused the term, but came to accept the importance of the concept. *Fortune* magazine hailed the idea in the 1950s, then Marshall McLuhan, musician John Cage, and artists Robert Rauschenberg and Andy Warhol all explored its applications. In the mid-1960s, Arthur C. Clarke visited Bell Labs to see if the company wanted to use some of its new technology in a film he was preparing. He saw a demo of a "singing" computer." The film, *2001: A Space Odyssey,* used a Bell Picturephone and featured a computer named HAL singing "A Bicycle Built for Two" as shown to Clarke at Bell Labs.

Counting Cards and Stocks

In 1962, Shannon's roulette partner, Ed Thorp, wrote *Beat the Dealer*, a book on his card-counting blackjack system. Gamblers made it popular, but casinos hated it and worked to foil card counters. Their tactics included using violence and crooked dealers, and even drugging Thorp's drinks. After failing to institute new gambling rules, the casinos introduced the permanent use of card holders ("shoes"), allowing dealers to shuffle multiple decks at once.

"To many portfolio managers today, the 19-year record of Princeton-Newport Partners is the definitive home run."

Thorp made about $25,000 playing blackjack, but abandoned cards in favor of the stock market. He read all he could about the markets and became interested in warrants, which are specialized instruments somewhat like options. Investors buy and sell warrants, which gain or lose value depending on the price of the underlying stock. In 1964, Thorp was working at the University of California at Irvine, where he teamed up with economist Dean Kassouf who also followed warrants. By 1967, Thorp turned his $40,000 trading account into $100,000. That year, Kassouf and Thorp wrote a book about their warrant trading system. *Beat the Market* included the first description of the "delta neutral" hedging system.

"In an efficient market, competition among the many intelligent participants leads to a situation where, at any given…time, actual prices of individual securities already reflect the effect of information based both on events that have already occurred and on events…the market expects to take place in the future."
[– *Eugene Fama]*

A former Philadelphia stockbroker, James Regan, asked Thorp to join a hedge fund as a mathematical theoretician. Regan planned to create the fund, raise the money and manage the partnership, called Convertible Hedge Associates after the convertible bonds it would trade. The fund was launched in 1969, and gained 13% in 1970, compared to a 3.2% gain in the S&P 500 Index. By 1971, it returned 26.6%, twice the S&P. In 1974, it was renamed Princeton-Newport Partners.

By 1982, Thorp and Regan's fund had successfully exploited arbitrage opportunities in the S&P 500 Index futures. In the course of taking a large position in the dissolution of AT&T (when the U.S. Justice Department broke it into seven regional "Baby Bell" companies), Princeton-Newport executed the largest trade in New York Stock Exchange history.

History's Best Hedge Fund

By 1986, Princeton-Newport's renowned trading record made it a focal point on Wall Street. But James Regan had gotten to know executives at Drexel Burnham's junk bond group, including Michael Milken. When investigators delved into Drexel for irregularities related to its junk bond business, they discovered that Princeton-Newport had engaged in a stock-parking scheme. This involved disguised stock sales and purchases intended to create artificial short- and long-term tax losses. In 1987, 50 federal agents raided the hedge fund's Princeton, New Jersey, offices. They found incriminating audiotapes about the stock-parking scheme.

"Everyone can't do better than average."

Rudolph Giuliani, then U.S. Attorney in New York, threatened the Princeton-Newport fund with federal RICO violations, and with securities violations against some of its employees. Under that threat, the fund ceased operations in December 1988. In 1989, a jury found the Princeton-Newport defendants guilty of 63 offenses, including racketeering. Regan was sentenced to six months in jail and a fine of $325,000, but all the charges were dropped on appeal and no one spent any time in jail. Later, when he was asked what happened, Thorp said the fund had been too aggressive in its tax management practices. He also cited personal differences with Regan. He said that if Regan had resigned, the hedge fund could have kept going and "we'd all been billionaires."

"The sad fact is, almost everyone who gambles goes broke in the long run."

Over 19 years, Princeton-Newport operated posted a compound annual return averaging 15% after fees, about twice the S&P 500's earnings over the same period. While Warren Buffett and George Soros' hedge funds beat it slightly, they were more volatile. Many consider the Thorp-Regan fund the most successful investment partnership in history.

About The Author

William Poundstone is the author of nine nonfiction books, two of which (*Labyrinths of Reason* and *The Recursive Universe*) were nominated for the Pulitzer Prize.