On Wall Street he and a few others—how many?—three hundred, four hundred, five hundred?—had become precisely that ... Masters of the Universe.


The Black-Merton-Scholes model, like many innovations, both succeeded and failed at the same time. It taught us that we could fly (or price options) but simultaneously created a desire for a performance level that it could not deliver. Judged from the latter perspective, undoubtedly unfairly, it was essentially dead on arrival. The absence of subsequent success from this viewpoint is merely indicative of the difficulties involved, though recent years have seen some partial successes.

Dilip B. Madan, 2001, (see References).

A more detailed examination shows that the lognormal model with a constant value of \( \sigma \) simultaneously overprices “at-the-money” options—that is, with \( K \) near \( S \)—and underprices options at the ends—either deep “in the money” or deep “out of the money.” This is an indication that the price process has “fat tails”: large changes are more frequent than would be predicted by extrapolation from the statistics of small changes.

Robert Almgren, (2002), (see References).

Many of these investors would not know they wanted to sell risk on the German bond market until we suggested it to them with our new warrant, just as people didn’t know they wanted to plug their ears all day and listen to Pink Floyd until Sony produced the Walkman.

Michael Lewis, 1989, (see References).
The Market is a large movie theatre with a small door.

An option veteran. (See http://www.pstemarie.homestead.com/)

There are no fixtures in nature. The universe is fluid and volatile.

Ralph Waldo Emerson. See
http://www.bartleby.com/cgi-bin/texis/webinator/sitesearch?query=volatile&db=db&filter=colQuotations

I told Michael to go into math because that’s where the money is.


... the Black-Scholes analysis may be done in at least three different ways. The PDE approach is to relate the theory of diffusion processes to diffusive (parabolic) PDEs and solve these. The martingale approach seeks a measure in which the price of the derivative is its expected payout. The binomial tree approach is in some ways the simplest: starting with a discrete-time formulation it obtains the Black-Scholes formula as the continuous time limit.


... arbitrage pricing depends on the ability to continuously trade the underlying asset: illiquidity was mainly responsible for the destruction in 1998 of the hedge fund (arbitrage engine) LTCM.


How did Enron lose so much money? That question has dumbfounded investors and experts in recent months. But the basic answer is now apparent: Enron was a derivatives trading firm; it made billions trading derivatives, but it lost billions on virtually everything else it did, including projects in fiber-optic bandwidth, retail gas and power, water systems, and even technology stocks. Enron used its expertise in derivatives to hide these losses.

Testimony of Frank Partnoy, Professor of Law, University of San Diego School of Law. hearings before the United States Senate Committee on Governmental Affairs, January 24, 2002. Taken from Financial Engineering News, June/July 2002, Issue No. 26.
Since the reason to forecast volatility is that it is time-varying, there is a logical inconsistency in using a framework that assumes constant volatility to estimate it.

T. Clifton Green and Stephen Figlewski, 1999, (see References).

According to this theory, one assumes that rational, equally well-informed and competitive agents are betting against one another in efficient markets—efficient meaning random and unpredictable in adjusting to the “correct” price. These assumptions, called the efficient market hypothesis, owe their origin to another Frenchman, Jean Louis Bachelier, who received a “B-” for the idea when it was presented as his doctoral dissertation in 1900.

Thomas A. Bass, 1999, (see References).

Every day someone discovers a new model that looks better than yesterday’s model for predicting the price of crude oil in New York or Deutsche marks in Chicago. Each new model demands more data, and in the furious scramble for numbers, one has to know precisely how many trading days exist in London and whether market $x$, when it opens, already knows the price in market $y$. Legion are the ways to trick oneself into thinking that one is predicting the future, when in fact, one is merely peeking into it by accident.

Thomas A. Bass, 1999, (see References).

The cost of trading is defined as market friction. It has two components: the fees charged by brokers for their service and market impact, which, for big orders, is by far the largest of the two costs. Impact is caused by traders pushing the prices higher the more one buys and lower the more one sells. Doyne can demonstrate this phenomenon simply by graphing the size of the order against the price shift caused by this order. It is a neat little experiment, but an expensive lesson.

Thomas A. Bass, 1999, (see References).

ARCH-type models fit at a given timescale $\tau$ do not appear to do a good job of explaining the volatility at a different timescale $\tau$. Furthermore, conventional ARCH models do not have asymptotic power-law decay in the volatility autocorrelation function. The most likely explanation is that ARCH models are misspecified—their simple linear structure is not general enough to fully capture the real temporal structure of volatility. Given that they are completely ad hoc models, this is not surprising.
J. Doyne Farmer, 1999, (see References).

Perhaps the most direct consequence of fat tails is their impact on risk control. With fat tails, the probability of extreme events can be orders of magnitude larger than it is with a normal distribution. For a fat-tailed distribution, the variance is an inadequate and potentially misleading indicator of risk. Failure to take this into account can be disastrous. This was dramatically illustrated in October 1998 by the near failure of Long Term Capital Management, which was apparently at least in part due to a lack of respect for fat tails.

J. Doyne Farmer, 1999, (see References).

For example, to estimate the daily correlations of the stocks in the S&P index, just to have the number of data points equal the number of free parameters would require about 500 years of stationary data. The S&P index has not existed that long, the composition of companies is constantly changing, and the nature of companies changes, so that the relevance of price history in the distant past is questionable. Five to 10 years is typically the largest sensible value of $T$ for most practical applications. Estimation errors are a big problem.

J. Doyne Farmer, 1999, (see References).

Since their inception, it seems that mystics, cabalists, and alchemists have been attracted to the financial markets, and there are many such people who, knowing some mathematics, will always hover around any group that will pay them the courtesy of listening.

J. Doyne Farmer, 1999, (see References).

The stories behind the losses emphasize the point made in section 1.5 that derivatives can be used for either hedging or speculation; that is, they can be used either to reduce risks or to take risks. The losses occurred because derivatives were used inappropriately. Employees who had an implicit or explicit mandate to hedge their company’s risks decided instead to speculate.

John C. Hull, 2000, (see References).

For example, finance books often describe a method called SOR, or successive over-relaxation, for pricing American options. It’s a pretty simple method. But what’s usually not mentioned is that this method is really bad for a lot of problems. There are ways to improve it, to increase its range of performance, but those issues
are never discussed. So financial engineers are taught the method and can implement it, but they don’t realize it has numerical properties, limitations, and that there are other ways to solve the problem it’s intended to solve.


We really cannot trade continuously, and trying to do so would drown a strategy in transaction costs. As a practical example, at the time of the 1987 stock market crash, several prominent funds were trying to follow “portfolio insurance” strategies, essentially synthesising put options by systematically selling stocks as prices declined. During the time of the crash, however, they found that the markets just dried up—they were unable to sell as prices plummeted.


It is difficult to imagine a word that conveys less information about these complex financial instruments than “derivative.”

Philip McBride Johnson, 1999, (see References).

Simulation is best regarded as mathematical experimentation . . .

Brian D. Ripley, 1987, (see References).

The sequence repeats itself after $m - 1$ values, which is a little over 2 billion numbers. A few years ago, that was regarded as plenty. But today, a 300 MHz Pentium laptop can exhaust the period in less than an hour. Of course, to do anything useful with 2 billion numbers takes more time, but we would still like to have a longer period.

C. Moler, (communicated by N.J. Higham).

From these somewhat frivolous beginnings, the theory developed to its present status, with applications to all branches of science, technology, and even to that citadel of uncertainty, the stock market.

Richard Isaac, 1995, (see References).

That a typical Brownian path has tangents nowhere is very interesting in light of the mathematics of the eighteenth and nineteenth centuries. Most mathematicians of that era believed all continuous curves had to have well-defined tangents, and there were repeated attempts to prove this. Finally, in the middle of the nineteenth
century, the German mathematician Karl Weierstrass gave an example of a continuous curve without tangents anywhere. This example must have appeared as an aberration to most of his contemporaries, the type of example that mathematicians often call pathological to indicate its unusual and unexpected nature. But from the point of view of Brownian paths (which, of course, were unknown at the time) the situation is just the opposite: the typical Brownian path has no tangents, and the totality of paths with tangents are the anomalies, having probability 0.

Richard Isaac, 1995, (see References).

Fate laughs at probabilities.

Edward George Earle Lytton Bulwer-Lytton, source
http://www.bartleby.com/100/427.21.html

Students today depend too much upon ink. They don’t know how to use a pen knife to sharpen a pencil. Pen and ink will never replace the pencil.

National Association of Teachers, 1907, source http://www.keypress.com/fathom/quotes.html

Don’t bother to sell your Gas shares. The electric light has no future.


The allure of this strategy is apparent to anyone who has visited a playground. Just as a seesaw enables a child to raise a much greater weight than he could on his own, financial leverage multiplies your “strength”—that is, your earning power—because it enables you to earn a return on the capital you have borrowed as well as on your own money. Of course, your power to lose is also multiplied.

Roger Lowenstein, 2001, (see References).

Merton was the son of a prominent Columbia University social scientist, Robert K. Merton, who had studied the behavior of scientists. Shortly after his son was born, Merton père coined the term “self-fulfilling prophecy,” a phenomenon, he suggested, that was illustrated by depositors who made a run on a bank out of fear of a default—for his son, a prophetic illustration.

Roger Lowenstein, 2001, (see References).

At one point during the road show, a group including Scholes, Hawkins, and some Merrill people took a grueling trip to Indianapolis to
visit Conseco, a big insurance company. They arrived exhausted. Scholes started to talk about how Long-Term could make bundles even in relatively efficient markets. Suddenly, Andrew Chow, a Cheeky thirty-year old derivatives trader, blurted out, “There aren’t that many opportunities; there is no way you can make that kind of money in Treasury markets.” Chow, whose academic credentials consisted of merely a master’s in finance, seemed not at all awed by the famed Black-Scholes inventor. Furious, Scholes angled forward in his leather-backed chair and said, “You’re the reason—because of fools like you we can.”

Roger Lowenstein, 2001, (see References).

This is called the normal distribution, or in mathematical terms, the lognormal distribution.

Roger Lowenstein, 2001, (see References).

Curiously Fama devoted the rest of his career to justifying the efficient market hypothesis. He argued that Black Monday had been a rational adjustment to a (one-day?) change in underlying corporate values. On the other hand Lawrence Summers, now the U.S. Treasury secretary, told The Wall Street Journal after the crash, “The efficient market hypothesis is the most remarkable error in the history of economic theory.”

Roger Lowenstein, 2001, (see References).

Q: How many Chicago School economists does it take to change a light bulb? 
A: None. If the light bulb needed changing the market would have already done it.

Source: http://netec.wustl.edu/JokEc.html

Interestingly, the Black-Scholes model was not the first model for pricing derivatives that was based on the principle that no arbitrage profits could be earned. Well prior to the days of Black and Scholes, agricultural economists knew that the price of a futures contract should be the price of the underlying spot asset increased by the costs of holding it and reduced by any implicit yield on the asset. This argument follows from the fact that the asset can be purchased and hedged using futures to produce a risk-free position that should yield the risk-free rate over and above any costs of storage less any yield. It is difficult to pinpoint who first identified this relationship, but see Blau (1944-45) for an early


Warren Buffett, one of the twentieth century’s great investors, says that investing in a market in which people believe in efficiency is like playing poker against those who believe it does not pay to look at cards.

Alexander Elder, 2002, (see References).

Jessie Livermore, a great speculator of the twentieth century, used to say that there is a time to go long, a time to go short, and a time to go fishing.

Alexander Elder, 2002, (see References).

The standard theory of contingent claim pricing through dynamic replication gives no special role to options. Using Monte Carlo simulation, path-dependent multivariate claims of great complexity can be priced as easily as the path-independent univariate hockey-stick payoffs which characterize options. It is thus not at all obvious why markets have organized to offer these simple payoffs, when other collections of functions such as polynomials, circular functions, or wavelets might offer greater advantages.


Knock-out options relate to ordinary options “the way crack relates to cocaine”, George Soros said in his 1995 book. He went on to explain why he thought they should be banned.


He that sells what isn’t hisn,
   Must buy it back or go to prison.


The principles of successful stock speculation are based on the supposition that people will continue in the future to make the mistakes that they have made in the past.

The speculator’s deadly enemies are: Ignorance, greed, fear and hope.


Derivatives are financial weapons of mass destruction.

The dangers are now latent—but they could be lethal.


By the latter part of the 1980s, derivatives were well developed in many areas and people were using them to build complex instruments. It was clear that these people weren’t engaged in financial analysis. To analyze means to decompose in order to understand. They were putting things together—and that’s the work of an engineer.


**Financial Engineering News**: Is there a “holy grail” for financial engineers today?

**Ingersoll**: Well, we’re still searching for a closed-form solution, a simple formula, to the problem of valuing American put options.


The forces of arbitrage—going back to the fundamental and unchanging truths behind efficient markets theory—will always enforce a discipline on the market. If something works well, then using it to buy and sell will affect prices so it works less well. As more and more people learn about the behavior quirk, it must go away as people try to profit from it first. For example, the widely-publicized “January Effect” seems to have gone away in recent years.


Prior to the 1987 market crash, the basic Black Scholes model was a fairly accurate predictor of market prices for stock options. It was only after 1987 that people began to talk about volatility “smiles” and “surfaces.” In my opinion, the existence of a volatility “smile” is evidence that, since the 1987 crash, investors believe
there is a reasonable probability that another substantial drop in stock prices is possible.


For the past twenty years, throughout Wall Street and the City of London, in most major and many minor financial institutions, small groups of ex-physicists and applied mathematicians have tried to apply their skills to securities markets. Formerly called “rocket scientists” by those who mistakenly thought that rocketry was the most advanced branch of science, they are now commonly called “quants.”


I have a friend who liked to point out the obviousness of various great discoveries in physics and finance. The obviousness is a delusion. Many things seem clear only once they have been taught to you in a historical context, with all the prejudices, confusion, and competing theories omitted. Every iota of discovery, in finance or theoretical physics, comes at the cost of long immersion, hard labor, and struggle.


I use to find it almost impossible to understand why the Nobel committee didn’t award the Prize for options theory before Fischer Black died. Everyone in the finance community knew that it was only a matter of time before Black, Scholes and Merton would receive the award, and it had been common knowledge for several years that Black was mortally ill with throat cancer. I’ve heard speculations that the Nobel committee was reluctant to give the award to someone who worked in the business world, especially in the profitable and untheoretical business of investment banking.


If it was evident that you hadn’t thought carefully about your question, you quickly discovered that he wasn’t going to do the thinking for you.

[about Fischer Black]

He was guided by his great economic intuition; though his mathematical skills were unexceptional, his instinct was strong, and he was tenacious enough in trying to attain insight before resorting to mathematics.

[about Fischer Black]


Sad to say, I discovered a little later that both my simulation program and my colleague’s contained small but different errors, which, once corrected, confirmed that the replication method rapidly converged to the exact Black–Scholes value! In his heart, though, Fischer [Black] mistrusted the Merton derivation and preferred his original proof.


I called Fischer [Black] (already ill but more than a year before his death) and left him a voicemail asking the appropriate way to refer to “the model”—should I call it “Black–Scholes” or “Black–Scholes–Merton?” Fischer replied with a message saying it was OK to call it the Black–Scholes–Merton model, because it was Merton who had come up with the replication argument for valuing an option. Then he added, quite imperturbably, that “that’s the part that many people think is the most important.”


Soon *Risk* was organizing expensive courses on exotic options, a clever arbitrage by which they charged quants from one set of investment banks to listen to the lectures of quants from another set, while *Risk* pocketed the fee.


With implied volatility as your measure of value, low-strike puts are the most expensive Nikkei options. Anyone who was around on October 19, 1987 could easily guess why. Ever since that day when equity markets around the world plunged, investors remained constantly aware of the possibility of an instantaneous large jump down in the market, and were willing to pay up for protection.
A model is only a model; you want it to capture the essence of the phenomenon, not the thing itself. It is far too easy, in the name of realism, to add complexity to the simple evolution of stock prices assumed by Black and Scholes, but complexity without callibration is pointless.

On a binomial tree, prices move like knights on a chessboard, one discrete step forward in time and up or down a notch in price. Binomial trees are easy to draw and, in a jerky way, mimic the behavior of real prices or indices.

As options theorists grew increasingly professional and better educated, binomial models fell into low-tech disrepute, but we still found them immensely useful.