

**HISTORY, PROBABILITY & STATISTICS,
AND THE FINANCIAL MARKETS**

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History, Probability & Statistics, and the Financial Markets

The philosopher George Santayana said, "Those who cannot remember the past are condemned to repeat it." Many investment "professionals" have taken this slogan to heart, spending an inordinate amount of time looking at the long ago past in an attempt to find support for predictions made about the near-term future. They have statistics pertaining to the amount of time it took for the market to eclipse the highs reached in 1929 before the Great Crash, the percentage decline peak-to-trough in the 1973-74 bear market, and an array of other factoids at their fingertips. Admittedly, clients and journalists often seem impressed at this type of command of market history. Precise statistics lend an aura of expert opinion. But does history have great divining power about what we should expect in the future? Paraphrasing Santayana, we would say, "Those who remember history, but are ignorant of basic probability and statistics, are condemned to erroneous forecasting."

The Gambler's Fallacy?

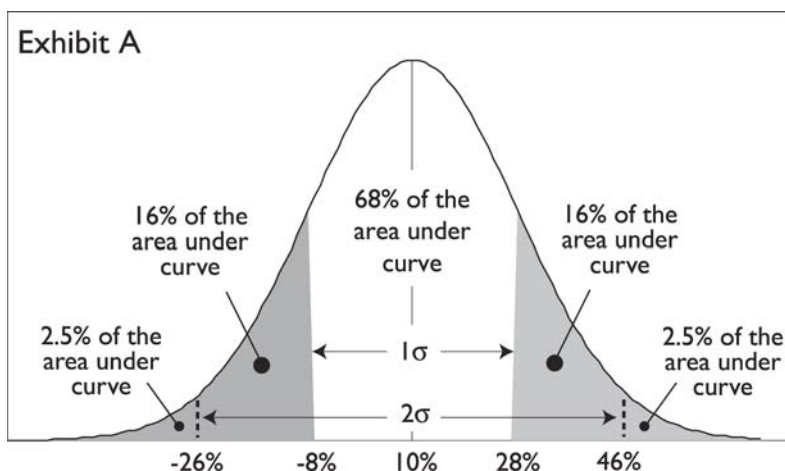
First, let's take the most naive error that is sometimes made by investors. Most people are painfully aware that the stock market, as measured by popular averages such as the Dow Jones Industrials and the S&P 500, has declined in each of the past three years. Consulting the financial history books, it is found that only once has the market declined four consecutive years in the last century, from 1929-1932. If four consecutive down years only happened once in 100 years, then there is only a 1% chance 2003 will be a down year, right? We read this argument made explicitly once, but more often than not, it is made implicitly in statements like "I can't imagine that we won't see stocks beat bonds and cash this year."

This argument, while cheerful, is horrendously wrong. Perhaps the easiest way to understand this is to consider the somewhat analogous situation of coin flipping. The chance of flipping seven consecutive heads is less than 1% (Fermat and Pascal first worked out these probabilities). However, suppose you have just flipped six consecutive heads. Is the chance that the next toss lands on heads less than 1%? No. The probability is the same as any other flip, 50%. The mistaken notion that the odds for something with a fixed probability increase or decrease depending upon recent occurrences is known as gambler's fallacy, and is an absolute dream for the folks who run Las Vegas casinos. The most succinct illustration of this is the story of a casino patron who asked the pit boss, "Aren't you worried about guys who come in here with systems?" The pit boss replied, "We send limos for guys with systems."

What Is Normal, Anyhow?

We said "somewhat analogous" above because in flipping a fair coin ("fair" means that each outcome, heads or tails, is as likely to occur as the other), each trial is an independent event. In an independent event, the result of one trial has no bearing on the outcome of any other. In more complex situations, like the stock market, exact probabilities are not fixed, and are relatively uncertain. In addition, each trial (the return in the next year) is dependent on other variables. The return for the equity market is dependent on a host of factors, including major ones like the price of stocks in relation to economic earnings, the level of interest rates, and the expected growth rate of corporate earnings. So what might be a more informed estimate of the probability that 2003 will be another down year? Another commentary we read asked this question and solicited the opinion of a professor who surmised 16%, a figure he thought was surprisingly high. Is this a reasonable estimate?

In the manner of economists, let's assume that the market return is normally (bell-shaped) distributed and, based on past experience, has a mean (average) of 10% and a standard deviation (σ) of 18%. Standard deviation is a measure of variation or dispersion of results around the mean. Does this offer any insight? To see, we'll briefly review some statistics, but try to be general and brief (in the interest of space, and because we could get out of our league). Exhibit A shows this normal distribution. The entire area under the curve is equal to 100%. There is an equal probability that the return is above and below the mean of 10%. Further, we should expect the yearly return to fall within one σ approximately 68% of the time and within two σ approximately 95% of the time. This would mean that we should expect the return to fall within the range of -8% and 28% (which is the mean of 10% \pm the standard deviation of 18%) more than two thirds of the time and within the range of -26% and 46% around 95% of the time. If the area under the curve between -8% and 28% is 68%



(shown in white), then the area outside that range must be 32% (all the shaded area with 16% of the area less than -8% the other 16% more than 28%). Thus, if returns are normally distributed with a mean of 10% and σ of 18%, the probability that the market returns less than -8% is 16%. The probability that the market is less than 0% is even greater, and can be calculated as a little less than 30%. These results would be generally consistent with the history of U.S. equity markets in the past century in that roughly one out of every three years has been negative.

(As an aside, experience in the capital markets has shown that financial market returns exhibit "fat tails"- meaning seemingly low probability events have occurred with much greater frequency than predicted by the normal curve given the historic mean and standard deviation of the U.S. equity market. This is one of the important lessons Roger Lowenstein illustrates in *When Genius Failed*, his book on Long Term Capital Management. Thus, the assumption of normally distributed returns is questionable. However, this should not dramatically affect our example since the "surprises" could be both positive and negative.)

So How About A Conclusion Already, Will the Market Be Up or Down in 2003?

Several conclusions might be drawn from our discussion above. The first is an explanation of why we might be logically reluctant to make short-term market predictions. Simply stated, in situations other than extreme conditions, chance variation plays too great a role on the ultimate outcome of any short-term market forecast for us to feel very confident in it. Imagine if someone asked a doctor his professional opinion and he responded, "I believe X, but I think there is a 30% or more chance it could be wrong." It is doubtful that the response would inspire confidence. However, with forecasting equity markets, this is the inescapable nature of the problem.

We deal with this problem in several ways. First, we look for situations that we believe are extreme situations. In most scenarios, we simply concentrate on individual stocks where we believe the price is significantly below what we believe it is worth, while remaining agnostic about the "market". If correct in our analysis, this will provide a margin of safety, which Benjamin Graham described as the three most important words in investing. Second, we use a fairly long time horizon. By doing so, short term "noise" is largely cancelled out. Finally, we do our best to remain objective and rational. People often seek out the advice they want to hear. This might mean looking for a doctor who will declare them healthy or a money manager who will tell them the market will be up huge. Our preferred characteristic in professional counsel is realism (e.g. the doctor who says, "I have thought long and hard and called upon my training. I believe X, but I will continually be looking for evidence that I am wrong, and the diagnosis should instead be Y.")

A second conclusion is that we believe assigning a 16% probability that the market could be down this year is far too low. If we had to guess if the market will be up or down, we would guess up, just as we would whenever we believed the expected return is positive. However, assigning a 16% probability is the equivalent of declaring that 5.25-to-1 odds that the market will be down is a "fair" bet. It is always insightful to invert, and consider the case that might be made that the person offering 5.25-to-1 odds is making a wise bet. Perhaps the professor analyzed the situation in the same manner as above, but used a higher expected (mean) return and/or a lower standard deviation, such as a 15% expected return and 15% σ . In previous reports, we've talked about the major variables (price in relation to earnings, interest rates, and earnings growth) and expressed the opinion that we have a difficult time justifying an expected return for the market

much above 8%. We rarely have much of an opinion on the expected σ , (having written before about why we believe it is a poor measure of true risk), remembering the wise man whom when asked what he thought the market would do deadpanned, "It will fluctuate." We would, however, observe that (1) strange things happen and (2) humans often behave emotionally rather than rationally. We would have no basis to predict that volatility will suddenly ameliorate from levels experienced in the past. Thus, if a mean of higher than 10% and/or a σ less than 18% were used, it would simply reflect a rosier viewpoint than ours. There is also the possibility that the professor analyzed the question in a completely different and better manner than using a normal curve (no model is likely ever perfect). Suffice it to say, if we were offered those odds, we would accept the bet confident that we had succeeded in gaining an edge. We would not, however, bet our entire net worth because there is the real possibility of losing. If we were to lose the bet and the same conditions prevailed, we would not hesitate to make the same bet again if we were confident in our analysis and the odds favored success.

And Is History Just a Waste of Time?

In high school, I had a history teacher who on the first day of class asked why we should even bother studying history. He proposed that if no one could come up with a valid reason, we would just use the class as a study hall. A fellow student submitted Santayana's adage almost verbatim. The teacher dismissed this reason immediately, arguing that people have been doing the same stupid things since the beginning of time and would almost assuredly keep doing them. Alas, we did have history class that year. The reason we should study history, according to this teacher, was for appreciation. This viewpoint, in my opinion is much too cynical. (A college professor of mine observed that most people tend to become more conservative and/or cynical as they age. He then advised to begin life with some level of idealism because if you started out cynical, imagine your worldview by the time you reach retirement age.) We believe studying history is very helpful in learning lessons and timeless principles. The key, however, is to learn the right lessons and be able to apply the principles to current problems.

Charlie Munger has vehemently stressed his belief that in approaching complex problems such as stock picking, one must have multiple models to use as tools. The basic mathematics involved in probability is one important model. If you do not have it and other models, he warns that "you will become the man with a hammer, to whom every problem looks like a nail." Relying too heavily on financial history runs the risk of this man-with-hammer syndrome. Consider this example. Suppose the market tripled in 2003 without a large increase in corporate profits or a decrease in interest rates. Relying solely on historical results, you might raise the expected return and σ , and judge conditions to be "normal". However, considering this new development (a higher price), we would argue the only correct judgment after considering fundamentals is to expect a much lower, probably negative, expected return. A detailed knowledge of financial history is fine, both for learning and appreciation, but for experience to be beneficial, critical thinking must be present. Otherwise, one can become like the gentleman Warren Buffet once described. A man interviews for a prospective opportunity and left a resume referencing "twenty years of experience." When the interviewer contacted the former employer for a reference, he quickly corrected the man's resume to read, "one year of experience, twenty times."

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