The Wise Investor

Statistical Significance

Executive Summary

- Periods that investors define as "long term" are mostly noise.
- Maintaining discipline requires that you don't extrapolate the recent past and draw erroneous conclusions from short periods, that amount to nothing more than noise.
- The formula for successful investing is simple, but "noisy" data means it isn't easy to implement. This makes the role of an advisor challenging but also extremely valuable.
- Don't trust any number that is not accompanied by a t-stat!

If you are short on time, this is a short but interesting interview with Dr. Gene Fama, the father of modern finance, by Canadian, Dan Richards. It touches on many of the concepts below:

http://www.clientinsights.ca/video/eugene-fama-is-warren-buffett-lucky-or-skilled/type:investor

Lies and Statistics

As the old saying goes, there are three kinds of lies: lies, damned lies, and statistics. It is true data can be tortured with statistical tools that will make it confess to almost anything. On the other hand, the average investor's ignorance about basic statistics and the role of chance might pose an even bigger problem, but that is a topic for another day. The objective of the following discussion is to bolster your understanding of a critical concept—*statistical significance*—so you don't blindly believe the lies.

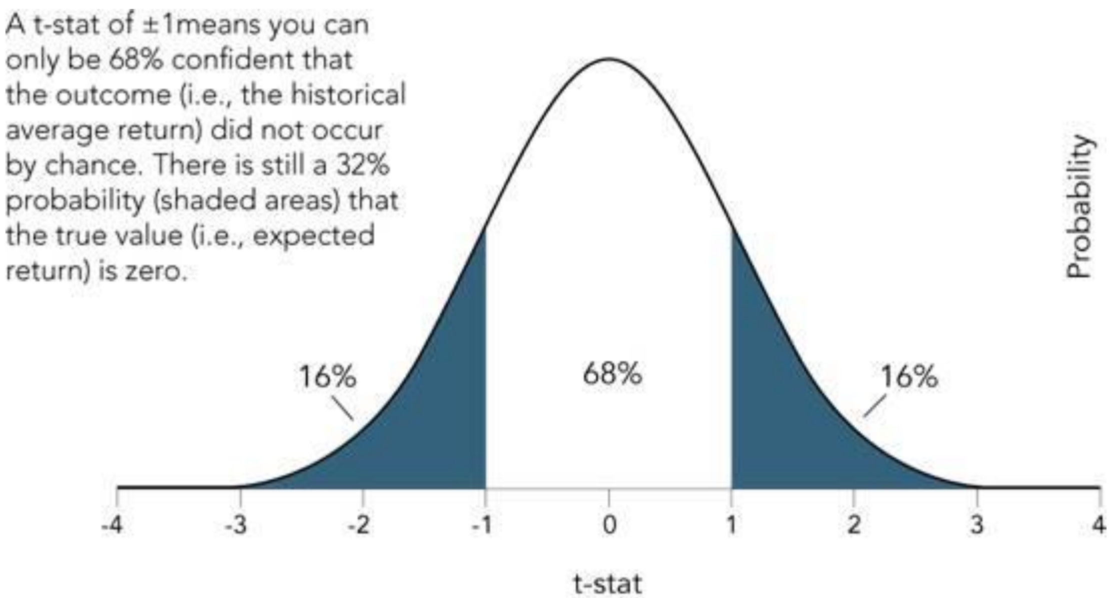
An analysis of historical data should aim to identify risk-and-return relationships without placing too much weight on a period-specific result. Consequently, empirical research should always incorporate statistical tests designed to calculate the likelihood that the results occurred by chance. This is referred to as statistical significance, and it will be discussed in the context of what many investors care about first and foremost—*expected* returns and risk premiums.

Statistical Significance and Expected Returns

The expected return tells us what returns we can expect going forward, or more precisely, it reflects the mean of the distribution. Since expected returns are unobserved, we often estimate them using historical averages. In an uncertain world, we can never know the "true value" of a result drawn from historical data. But computing a t-statistic can help us determine whether the value is "statistically significant," and if so, it enables us to rule out that the true value is zero.

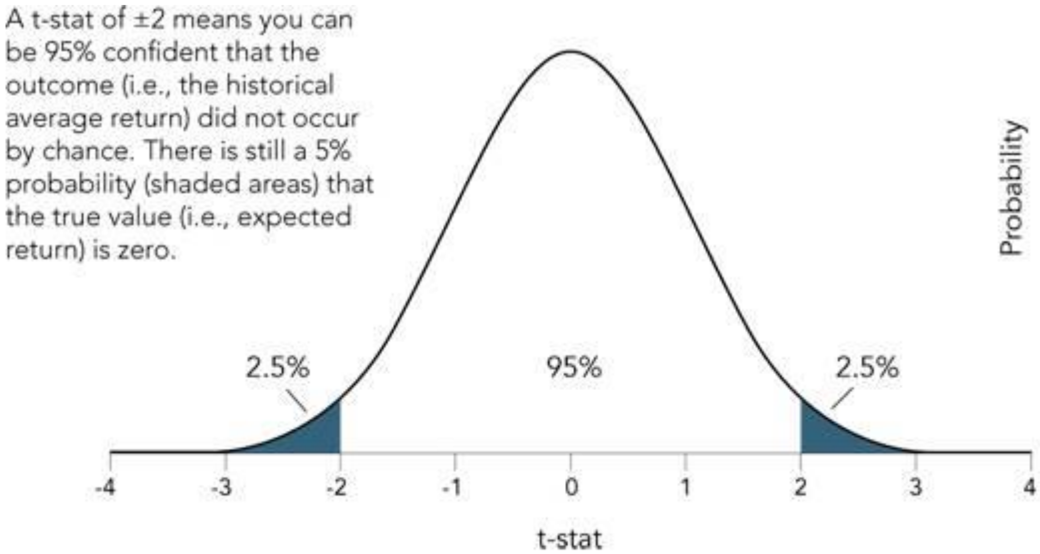
Assuming the expected return has a zero mean, the t distribution in Chart 1 shows that the probability of getting a t-stat beyond ±1.0 is 32%. At that level, we don't have condemning evidence that the expected return is not really zero since 32% is a pretty high probability. In other words, if we assume the expected return is different from zero, there is a 32% chance that we'd be wrong.

Chart 1. t-distribution highlighting a t-stat range beyond ±1



So how large of a t-stat do we need before we're comfortable saying the expected return is not zero? The conventional approach is to draw that line at 5% statistical significance. As shown in Chart 2, this corresponds to a t-stat of ±2. That is, there is only a 5% chance of getting a t-stat of ±2 or more if the expected return *is* really zero, or said another way, you can be 95% confident the expected return is not zero.

Chart 2. t-distribution highlighting t-stat range beyond ±2



If you can't live with a 5% chance that you could be wrong, then you simply require bigger t-statistics to be confident the expected return is not zero. You can be 99% sure with a t-stat of ±2.6!

Keep in mind the normal distribution goes on forever, and there will always be some tiny probability that the true mean *is* zero even if we get a large t-stat, but we have to draw the line somewhere

Examples: Risk Premiums

Illustrating how this applies to real data might help solidify the concept. I regularly discuss three types of expected returns: the market premium, the value premium, and the size premium.

An important consideration for investors is the likelihood that these risk "premiums" are actually zero (i.e., there is no premium) despite a historical mean that is positive. As discussed, the starting point is calculating a t-stat for each return series as outlined in Table 1 below. In this study I will limit my observation to the "market (US Equity Premium)."

Table 1 US equity risk premium: t-stat

1927–2010

	t-stat
US Equity Premium (RM — RF)	3.52

The t-stat above is considered statistically significant (i.e., greater than 2), and we can almost be 99% sure that the risk premium is positive.

Solving for T

Fama and French often remark that it requires an investment lifetime for risk premiums to be reliable. Why? We can input values for the average premium and standard deviation from Table 2 into the equation for t-stats but rearranged to solve for T, and find the T that gives us a t-stat of 2.

T = [(t-stat x standard deviation) / average return]²

For example, the historical average US equity premium was about 8% with a standard deviation of 20%. If we plug those values into the equation above and set the t-stat equal to 2, then the result for T is 26 years! This means it takes twenty-six years of data before we can say the equity premium is reliably different than zero.

Table 2. US equity risk premium: minimum years of data for statistical significance (t-stat > 2)

1927–2010

	Years
US Equity Premium (RM — RF)	26

Many advisors and portfolio managers, never mind investors, are initially surprised to learn the number of years required for historical observations of risk premiums to be considered "statistically significant." Uneasiness may set in from the notion that you must invest for twenty-six years in order to earn a positive return.

This is no doubt a daunting proposition, considering that most investors don't interpret results over an investment lifetime but over intervals more likely in the range of three to five years. Unfortunately, a period of five years amounts to nothing more than noise because, as explained above, a small number of observations will likely result in a small t-stat. The consequence: Few, if any, inferences can ever be drawn from periods that many investors consider long term.

It is important to distinguish between (a) the number of observations required to determine whether a risk premium is likely to be different from zero (t-stat > 2) and (b) how long an investor must wait for positive risk premiums to be realized. The latter can materialize over short periods of time; however, the length of time demanded of the former supports the notion that investing is a risky proposition and that investors can experience prolonged periods in which they are not rewarded for the risk they took. Table 3 outlines the longest historical periods without a positive equity premium.

Table 3. US equity risk premiums: longest period without a positive risk premium

1927–2010

	Duration	Time Period
US Equity Premium (RM — RF)	~16 years	November 1958–August 1974

Conclusion

Many of you probably vowed not to revisit these concepts after closing the book on your last statistics exam in college, but if you are still reading at this point, hopefully you have gleaned a few key points from this overview.

Despite the propensity of investors to look at results over short horizons, an understanding of the statistical properties of market returns reinforces the notion that these periods amount to mostly noise. Investors without a grasp of basic statistics could draw erroneous conclusions by simply looking at the point estimates from a short sample period.

This is particularly important when setting expectations because risk premiums have been (and will be) zero, negative, or lower than expected over time frames that investors consider to be long periods.

While we do know these periods are bound to occur, unfortunately we don't know when. For this reason, the contributions that I make to setting the right expectations and bringing discipline to the process are both crucial and extremely valuable, in my opinion.

If you take anything away from this discussion, the points to remember are:

- Periods that investors define as "long term" are mostly noise.
- Maintaining discipline requires that you don't extrapolate the recent past and draw erroneous conclusions from short periods, that amount to nothing more than noise.
- The formula for successful investing is simple, but "noisy" data means it isn't easy to implement. This makes the role of an advisor challenging but also extremely valuable.
- Don't trust any number that is not accompanied by a t-stat!

Kindest regards,

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