



Risky Business III The Myth of VaR – Use Your Illusion

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First, we at WoodedPark Strategies would like to thank all our clients and colleagues for reading our previous articles and sharing our articles with your network. Most importantly, we couldn't be more grateful for the feedback we have received across a wide variety of disciplines and genres.

We look forward to an ongoing dialogue of Risk: what it is, how it is measured and how it should be managed. The first article of the "Risk" trilogy defined Risk, and the second article used *Volatility* as one way to measure Risk. This article focuses on the industry-wide and commonly used term VaR (Value at Risk).

As option traders for over twenty years, we understand why VaR has become so ubiquitous, as it is fairly easy to calculate, and the output is one number based on how many standard deviations one wishes to use. Wouldn't it be great if one number could tell you how much risk you were truly taking in any discipline? Think about the cockpit of a new commercial aircraft. Do the pilots look at one instrument and one instrument only to manage their risk? Of course not, which is why we believe that VaR is dubious at best, and overwhelmingly dangerous at worst; however, before we begin our assessment with respect to VaR, we need to give it its fair day in court, so let's begin with the following question: "What is VaR?"

VaR Explained

VaR can (and usually does) come in all shapes and sizes and is bound by the mathematical foundation that defines it. There are many types of VaR which you may be familiar with or have heard of: parametric VaR, delta-gamma VaR, cVaR (VaR with a calculation for the credit worthiness of a portfolio), Enhanced VaR which is VaR with significant events added into the calculation such as the attack on the US on 9/11/2001, Hurricane Katrina, the Gulf War in 1991, etc., two-sigma VaR, three-sigma VaR, and so on. Let's define VaR in its basic form.

VaR is a measure of the risk of loss for investments. It estimates how much a set of investments might lose (with a given probability), given normal market conditions, in a set time period such as a day. VaR is typically used by firms and regulators in the financial industry to gauge the amount of assets needed to cover possible losses. For a given portfolio, time horizon, and probability p , the p VaR can be defined informally as the maximum possible loss during the time if we exclude worse outcomes whose probability is less than p . This assumes mark-to-market pricing, and no trading in the portfolio. For example, if a portfolio of stocks has a one-day 5% VaR of \$1 million, that means that there is a 0.05 probability that the portfolio will fall in value by more than \$1 million over a one-day period if there is no trading. Informally, a loss of \$1 million or more on this portfolio is expected on one day out of twenty days (because of 5% probability). A loss that exceeds the VaR threshold is termed a VaR breach.

Now let us define VaR mathematically in its most common form:

The VaR of X at the confidence level $\alpha \in (0,1)$ is the smallest number y such that the probability that $Y := -X$ does not exceed y is at least $1 - \alpha$.

Mathematically $\text{VaR}_\alpha(X)$ is the $(1 - \alpha)$ -quantile of Y , i.e.,

$$\text{VaR}_\alpha(X) = \inf\{x \in \mathbb{R} : F_X(x) > \alpha\} = F_Y^{-1}(1 - \alpha).$$

Now that the simple math part is defined, let us make the discussion easier: VaR uses a chosen distribution that is historically bound, both to the upside and the downside, and produces a number that is intended to encapsulate the risk in a portfolio.

The Rub

You may have had a conversation with vernacular such as the following: “I have \$1.5mm of VaR”, or “The entire desk is running \$7mm of VaR”, or “We better not lose more than X amount of dollars, as our VaR is only \$500,000”. VaR makes the conversation about risk very rudimentary, as it distills and synthesizes it into one simple number to be discussed. And therein, as all of us like to say, lies the rub: it is next to impossible to truly understand the actual risk you are taking by looking at VaR and VaR alone.

No commercial aviator would look at just her altimeter while on approach to land. No fighter pilot would only look at his artificial horizon (attitude indication) while in a dogfight or taking off from an aircraft carrier.

Risks are not static, and a change in one risk can affect the position in others that VaR does not properly capture. We believe that the bottom line is as follows: VaR is simply one data point when looking at the Risk in your portfolio, but it has significant flaws that could (and does way too often) lead to disaster.

Real-World Examples of VaR's Danger

Let's look at two actual events that we believe will prove our hypothesis, not only by the preponderance of evidence, but beyond a reasonable doubt:

First, in 2008/2009 one of the largest and most successful hedge funds in the world used “Enhanced VaR” to calculate their risk (e.g. worst case scenario) for their entire portfolio. The people who populate this firm are some of the smartest people in their fields, including computer scientists, physicists, data engineers, experienced non-linear thinkers and portfolio managers. Tens of millions of dollars were spent on modifying traditional VaR to include as many events as possible, and the risk team was extremely confident that VaR, along with the many modifications they so diligently made, would produce a reliable number. Let's see how that worked:

“In 2008, a multi-billion-dollar hedge fund managed by a leading quant used ten-day windows from the crash of 1987, the First Gulf War, Hurricane Katrina, the 1998 Long-Term Capital Management crisis, the tech induced market drop in 2000-02, the Iraq War, and so forth. All this data was applied to the fund’s portfolio and showed that these events would have led to losses of at most \$500 million on a \$13 billion portfolio, a risk of no more than 4%. But they actually lost over 50% at their low in 2009, brought to the brink of ruin before finally recovering their losses in 2012.” – [“A Man for All Markets” by Edward O. Thorp \(January 24, 2017\).](#)

The answer: clearly not so well.

Second, a major global investment bank that also had some of the top people in their fields used their version of “Enhanced VaR” to manage their Risk, which was included in their public filings, as well as their filings to the agencies that regulated the bank in the United States and abroad. Let’s see how that worked:

“Deutsche Bank traders suffered a staggering one-day loss in the first quarter that was almost 12x VaR, or 12 times what DB's risk officers have estimated for regulatory purposes it might lose on a typical day.”

[Bloomberg Deutsche Bank Loses 12x their VaR \(June 20th, 2018\)](#)

The answer: once again, clearly not so well. We are being kind at this point. It is preposterous that a global regulated bank operating in the United States could suffer a worst case scenario twelve times worse than what their “worst case scenario” could envision.

These are just two significant examples of how VaR overwhelmingly underestimates the Risk in a portfolio. Statistically, they should have lost 12x their VaR once every ~5,000 years.

Use Your Illusion

We believe that too many people in the risk-taking business have grown to rely heavily on VaR in lieu of doing the hard work of developing a multi-dimensional and varied understanding of Risk. They are not congruent, as the above examples clearly display.

The only way to truly understand the Risk in your portfolio is to stress-test it in as many ways as possible. Proper stress-testing doesn’t involve looking at historical data that bounds you to the past. It looks forward, as it should, as almost anything can happen, and if you are not able to see how your portfolio performs by shocking it with large standard deviation moves (e.g. five to twenty σ moves in price, volatility, correlation, credit, etc.) you will eventually face a cataclysm that you never expected.

In the aforementioned first example, the illustrated hedge fund wisely decided to move in a different direction and started truly stress-testing their portfolios over 500 times per day. This new path was so meaningful, that is it prominently displayed on their website. They are now one of the top hedge funds in the world, and they continue to grow across many different asset classes.

WoodedPark Strategies offers our clients suggestions to this industry-wide problem: if you use VaR, continue to do so, but (a) understand its limitations, and (b) supplement it with stress-testing. Our patented software product is a modular, ultra low-latency true stress-testing solution that will stress-test our clients' portfolios whether it is comprised of equities, bonds, futures, options, currencies, financial and physical commodities, et. al.

In addition to VaR, our software solution can aggregate risk across an entire portfolio, business unit or company, and stress-test the data to find situations that could cause significant damage to the profitability and stability of an organization. Once this process is complete, we offer advice on how to best hedge and manage the Risk we discover to avoid the example listed below:

[American Airlines is reporting that profits during the second quarter plunged more than 30 percent due in part to rising fuel costs \(July 26th, 2018\)](#)

We look forward to your hearing your valuable feedback.

AfterMathematics™ is the ultra low-latency software solution provided by [WoodedPark Strategies, LLC](#)

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[WoodedPark Strategies, LLC](#) is a privately held risk management advisory firm located in Houston, TX.