

## Increase the value of investment management with enhanced-MPT tools

NAPFA clients tend to do their homework before selecting a financial advisor. Many are committed to comprehensive planning, but uncertain about the value of investment management. They have learned that it is impossible to beat the market. They think, why hire an advisor to seek above-market investment returns? What they fail to recognize is that the true value of investment management is not higher returns but better risk management.

While some individual investors are aware of Modern Portfolio Theory (MPT) and asset allocation, many are unable to execute. When they feel the market is risky, they run to cash; when markets are good, they go all in on risky assets. Others don't believe MPT is relevant in the real world because it uses mathematical modeling based upon projected values and unrealistic assumptions.

However, MPT is a major innovation that offers a strategic foundation for managing risk. Moreover, a revolution, driven by academics and investment pioneers, is slowly and quietly overcoming some of MPT's limitations. Researchers are exploring the limitations of traditional portfolio theory, supplanting the simplistic and unrealistic concepts taught at universities and in certification programs such as the CFP® and ChFC. Portfolios that incorporate features from this "enhanced MPT" further reduce downside risk, and look very different than the traditional mean-variance-optimization portfolios that are at the heart of MPT.

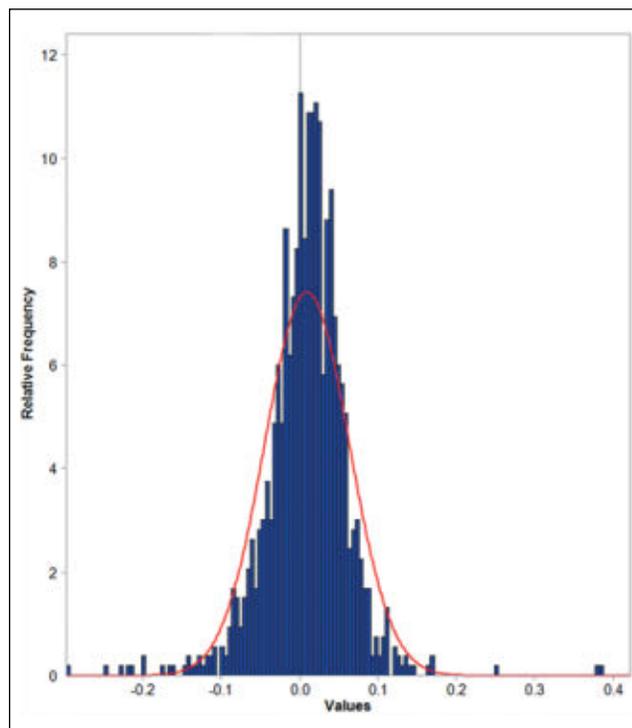
### Main limitation of traditional mean-variance theory

Essential to traditional theory is the assumption that asset returns are normally distributed. However, this is not true for most asset classes. A normal distribution has the following characteristics: It is symmetrical (no skew), it has a kurtosis (a measure of the fatness of the tails) of 3.0, and its tails have very few occurrences of returns that exceed 99% of the width of the distribution. Table 1 compares the expected values of a normal distribution with the actual values of these characteristics for three common asset classes.

In a normal distribution, the median is the mean, and peak return is shown as a bell-shaped curve depicted by the red line in Figure 1. Compare the red curve with the historical monthly fitted returns for the S&P 500 (blue bars) highlighting the skewed distribution caused by several very large negative returns during the period 1926 to 2019.

The assumption that asset class returns are normally distributed is one of the main limitations of MPT. This mistaken assumption leads to the four main problem areas with a traditional MPT approach, which will be discussed below: correlation measurement, risk measurement, risk-return measurement, and the effect of regime changes on returns and correlations.

**Figure 1: S&P frequency distribution compared to the normal distribution curve**



**Table 1: Skewness, kurtosis, and tail risk of common asset classes<sup>1</sup>**

Asset class	Skew		Kurtosis		1% tail risk (monthly return)	
	Normal distribution	Actual distribution	Normal distribution	Actual distribution	Normal distribution	Actual distribution
S&P 500	0.0	0.3	3.0	12.8	-12.0%	-15.0%
REITs	0.0	-0.7	3.0	10.9	-11.0%	-18.0%
Commodities	0.0	-0.5	3.0	5.5	-9.3%	-12.0%

**Problems with traditional correlation measurement**

Because investment returns are not normally distributed, the Pearson Rho correlations used in MPT to model interrelationships between asset classes are unstable and nonlinear, which increases exposure to downside (shortfall risk). Even when using all the historical data available, correlations can change dramatically during different market regimes. Corporate bonds, for example, have low correlations with stocks during market rallies, but high correlations with stocks during market sell-offs. Table 2 shows large-cap stocks’ interrelationships with REITs and bonds under different market regimes, illustrating how correlations can be misleading.<sup>2</sup>

**Table 2: Correlation for large-cap stocks with REITs and bonds under different market regimes**

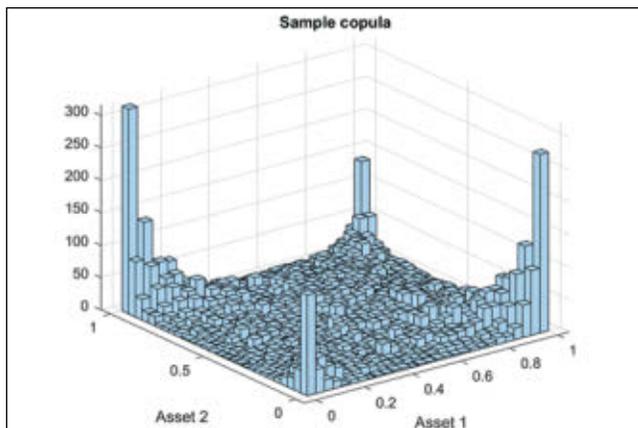
	Left tail (sell-off)	Normal distribution	Right tail (rally)
REITS	0.56	0.30	0.01
Corporate bonds	0.54	0.25	0.07
High-yield bonds	0.76	0.28	-0.03

**Enhanced-MPT tool for identifying interrelationships for robust allocations**

There are two ways to model these interrelationships. Enhanced-MPT models can incorporate one or both of these approaches:

- Create a “composite” correlation that weights risk-on (high-volatility market regimes associated with bear markets) correlations with risk-off correlations (low-volatility market regimes associated with bull markets).
- Use a much more complex mathematical construct called a “copula.” Copulas replace the single-point correlation with a mathematical probability distribution that can take on complex shapes. They are much better at modeling nonlinear relationships, and they can incorporate unsymmetrical correlations and extreme events. Figure 2 illustrates the dimensionality of a copula.

**Figure 2: Visual depiction of a copula**



**Problems with traditional risk measurement**

Dr. Harry Markowitz chose variance—standard deviation squared (SD)—as the measure of risk (he would have preferred semi-deviation but for various reasons, including the complexity of optimizing, he did not adopt it). Using SD is problematic for a few reasons:

- It is only appropriate when distributions are elliptical and symmetrical (normal, Student’s t-distribution, etc.).
- It treats upside surprises as equal in importance to downside surprises.
- It does not identify the magnitude of downside risk in the portfolio.

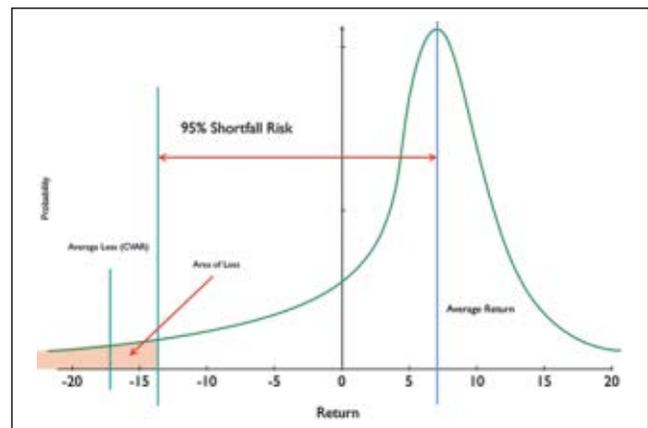
**Enhanced-MPT tool for identifying risk**

Conditional value at risk (CVAR), like SD, is a coherent measure of risk<sup>3</sup>, and it can be used as part of enhanced MPT to correct for the problems of SD. Like SD, CVAR has the important property of subadditivity, meaning that the risk of a weighted combination of investments must always be equal to or less than the risk of the individual components. CVAR is preferable to SD for several reasons:

- It only considers left-tail events, which are the only ones that concern investors (see area of loss in Figure 3).
- It works with non-symmetrical distributions.
- It provides some information about the magnitude of an average decline once some threshold is crossed—for example, the worst 10% of events or the worst 5% of events.
- In our experience, it leads to more balanced portfolios when used to optimize, in contrast to mean-variance optimization, which sometimes creates allocations with only two or three asset classes.

Portfolios that have been optimized using CVAR may actually have a higher SD than those created under traditional mean-variance approaches, but they will have less shortfall or downside risk. Table 3 shows two sample optimizations—one with SD minimization and the other with CVAR minimization.<sup>4</sup>

**Figure 3: Conditional value at risk (CVAR)**



# INVESTING

**Table 3: Comparison of optimized portfolios (reduced volatility vs. reduced downside risk)**

Asset class	Mean-variance optimization	Min. CVAR optimization
Government bonds	19%	13%
BarCap Aggregate	14%	3%
Reinsurance bonds	0%	2%
Commodities	12%	20%
REITs	6%	4%
Domestic large equities	20%	33%
Domestic small equities	0%	6.5%
Foreign fixed income	3%	2%
Foreign developed markets	14%	7.5%
Liquid alts	12%	9%
Return	7.5%	7.5%
CVAR (10%) (Monthly)	5.9%	5.4%
Standard deviation	2.90%	3.90%

## Problems with traditional risk/return measurement

Markowitz used arithmetic rates of return, assuming the efficient frontier would be recreated each year, and adjustments would be made to the portfolio. But the efficient frontier uses geometric—instead of arithmetic—rates of return (see Figure 4). Since the geometric return is always less than the average return unless the investment has zero volatility, the returns predicted by the geometric efficient frontier will be less than those predicted by an efficient frontier created using arithmetic rates of return, and they will also be more realistic and accurate.

## Enhanced-MPT tool for multi-period asset allocation

Enhanced MPT can address this shortfall, but, unfortunately, we have seen few software programs that use geometric rates of return. Investment advisors should consider modifying their classic mean-variance optimization software to generate the geometric mean frontier. Figure 4 illustrates a more realistic diminishing marginal return to risk accompanying overly aggressive portfolios when using the geometric mean.

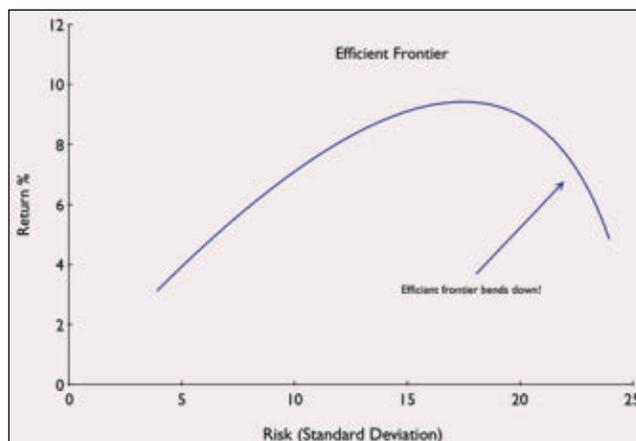
## Problems with ignoring regime change

It is well known that equity markets can be in different states or regimes. A low-volatility regime is typically associated with higher returns, and high-volatility regimes are associated with low or negative returns. During times of turbulence, investors flee risky assets to seek harbor in riskless assets like Treasuries. Table 4 illustrates the difference in annualized returns.<sup>5</sup>

**Table 4: Performance under volatile and non-volatile regimes**

	10% most volatile months	Other 90% of the months
U.S. equities	-5.5%	13.7%
Foreign developed equities	-10%	13.1%
Emerging markets equities	-43%	20.4%
Commodities	-12.5%	8.2%

**Figure 4: Geometric efficient frontier**



## Absorption ratio: a tool for identifying regime changes

A change in regime can be measured using principal component analysis to identify the amount of systematic risk in the markets. Kritzman (2010) defined the absorption ratio (AR) as the fraction of the total variance of a set of returns that can be explained by a fixed set of eigenvectors (common factors) in a principal component analysis.<sup>6</sup> If the ratio is low, the market is less vulnerable to economic shocks. The AR has been shown to have some predictive value, and portfolio allocations adjusted on this indicator have shown improved performance.<sup>7</sup> Using this signal to rebalance or even maintain two portfolio strategies—one for risk-on regimes and one for risk-off regimes—could reduce risk and enhance performance.

## The value of investment management

Critics of MPT contend it does not deal with the real world. However, it is a mistake to discount its value. As fiduciaries, advisors managing investments must consider every technique available to reduce investment risk. This requires a complete understanding of what MPT can do and where it is limited. It also requires the advisor to understand and apply the new scientific tools that ameliorate the limitations of MPT.

Moreover, user-friendly software must be developed to apply these tools for the use of enhanced MPT. We've applied them by using a combination of the MATLAB<sup>8</sup> programming language, Microsoft Excel, and Excel

## Want to learn more about new approaches to MPT?

Please contact Steve Craffen and Laura Mattia if you're interested in helping them to develop user-friendly tools for implementing enhanced MPT. They had been scheduled to speak on "Navigating the Global Marketplace in an Era of Heightened Volatility" at the NAPFA Spring Conference. NAPFA hopes to reschedule them to a future conference.

# INVESTING

add-ins (ModelRisk<sup>®</sup>), but that's not a user-friendly solution. This continuous evolution of theory (and tools) will assist in guarding against risk. It is this action that creates the value of investment management. 

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- 1 All data is from the longest time period available through year-end 2019: S&P data since 1926, REITs since 1978, commodities since 1991.
- 2 Paige, Panariello, 2018. "When Diversification Fails." *Financial Analysts Journal* 74 (3): 19-32
- 3 Meucci, Attilio, *Risk and Asset Allocation* (New York, Springer, 2007), 278.
- 4 We are not recommending these portfolios; this is purely an example. This is based on historical data for each asset class, no views on future returns have been incorporated, and minimal constraints on the optimization have been imposed.
- 5 Kinlaw, Kritzman, Turkington, *A Practitioners Guide to Asset Allocation*, (Hoboken, Wiley, 2017), 124
- 6 Kritzman, Li, Page, and Rigobon, "Principal Components as a Measure of Systemic Risk," *Revere Street Working Paper Series, Financial Economics*, 272-28, March 2010
- 7 We have written code in Matlab to implement this analysis.
- 8 <https://www.mathworks.com/products/matlab.html>
- 9 <https://www.vosesoftware.com/products/modelrisk/>

## DO YOU COMPETE ...

*Continued from page 11*

Don't get me wrong, I think we should all compete vigorously in our markets. Tom's line of questioning was not out of bounds in and of itself. Asking about tax planning is perfectly acceptable to me. The context in which he asked is what made it unprofessional. Tom was obviously there hunting for business. And there is nothing inherently wrong with that, either. However, the way Tom did it made him come across as a predator, and made my friend feel a bit like prey. The financial planning profession doesn't need that image.

Our success at helping clients is critical to advancing our profession. The more clients we serve, the better. My hope is that in the quest to help more people, we are mindful of how we conduct ourselves, and are supportive of our peers even when we're competing. If our profession gets good at this, we will further elevate ourselves above the shenanigans we so often see from the others who call themselves "financial advisors." 

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*Dan Moisand, CFP<sup>®</sup>, is a principal at Moisand Fitzgerald Tamayo. A NAPFA member since 2000, he is a past national president of the FPA and was named one of 15 leaders who "transformed the business of financial advice" by InvestmentNews.*

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