# FEATURE ARTICLE I

# Non-Normality Distribution Approach: Was It the Solution to The Fall of '08?©

BY KATHLEEN A. GRAHAM

*So how then do we improve to "best" our decision processes? First, by staying constantly aware of the common errors we make when utilizing heuristics or decision shortcuts.* Tim Kelly (2009)

The 1636-37 Dutch tulip bulb crisis; the 1719-20 South Sea and Mississippi Bubbles; the 1745 Black Friday and panic; the 1763 crisis; the 1772-73 Amsterdam and Great Britain crisis; the 1783 crisis; the 1793 Great Britain crisis; the 1808-09 crisis; the 1816 crisis; the 1819-22 crisis; the 1825 panic; the 1825-6 crisis; the 1825 and 1836 Anglo American crises; the 1828 Alsace crisis; the 1836-7 panic; the 1836-9 crisis; the 1847 commercial crisis; the 1854 U.S. panic; the 1857 panic and crisis; the 1864-66 crisis; the 1867 Black Friday; the 1870s depression; the 1873 crisis; the 1882 crisis; the 1884 New York Stock Exchange crash; the 1890 Baring crisis; the 1906-7 crisis; the 1907 panic; the 1918-20 Ponzi scheme; the 1920-21 U.S. crisis; the 1929 stock market crash; the 1929-33 Great Depression; the 1931 Austria-Hungary crisis; the 1980s Japanese real estate bubble; the early 1980s Latin American debt crisis that includes the 1982 Mexican crisis; the 1987 Black Monday, stock market crash, and crisis; the 1989-91 U.S. savings and loan crisis; the 1990 Japanese crisis; the 1990s-2009 Bernie Madoff scam; the 1992 western European exchange rate mechanism crisis; the 1997 East Asian, Brazilian, and Russian crisis that was followed by the Long-Term Capital Management blow up; the 1998-2001 dot-com bubble, the 2002-6 U.S. housing bubble followed by the 2007-present subprime mortgage crisis; and The Fall of 2008-The Great Recession present crisis—"**with so many lessons over time, why doesn't our industry (finance professionals) seem to get any better at spotting and protecting against developing bubbles?**" asked Tim Kelly in his article "Decision Making and Market Crises" that's featured in the 1st Quarter 2009 issue of *HQ Financial Views*.

## BUBBLE AVOIDANCE APPROACHES

Many brilliant minds have addressed that question in 2009, focusing their comments particularly on the latest crisis: The Fall of 2008—The Great Recession.

Some, such as the former Fed Chairman Alan Greenspan thought that **"it was very difficult to definitively identify [a] bubble until after the fact…The idea that the collapse of a bubble can**

**be softened by pricking it in advance is almost surely an illusion."** (7/17/09 M. Hennigan article, 2002 quote in Finfacts, www.finfacts.ie)

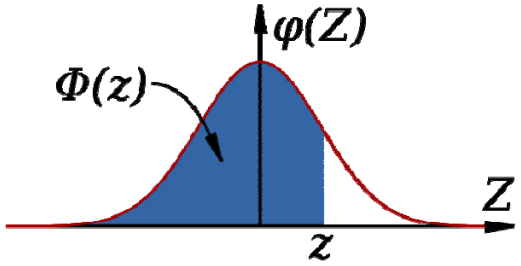
Others, such as Dr. Stephen Roach, the former Chief Economist for Morgan Stanley and the current Chairman of Morgan Stanley Asia, categorically rejects **"the 'inevitability excuse'—the notion that the world has once again been engulfed by the proverbial 100-year tsunami. This all too convenient justification is nothing more than a cop-out by those who were asleep at the switch during the Era of Excess. Yes, cycles of fear and greed date back to the inception of the markets. And those powerful animal spirits were very much at work this time, as well…There is compelling reason to hold the stewards of the financial system… accountable for much of the blame."** (6/22/09 speech, Rafael del Pino Foundation, Madrid, Spain)

## THE NON-NORMALITY MODEL VIEW

Yet another viewpoint sidesteps whether emerging crises can be spotted and pricked before they burst by focusing on the supposed defects of the models used to invest in the markets that prevent money managers from protecting investors' assets if and when a crisis or bubble occurs. The common themes in this viewpoint are that:

- the conventional approach of using Harry Markowitz's mean-variance theory doesn't take into account the non-normality of tail risk because it is based upon the assumption that future asset class returns are normally distributed.
- that there are various better methods to address these non-normality tail risk aspects of market returns.

**Illustration 1: Normal distribution**



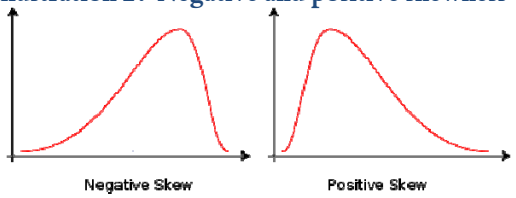

Before discussing these methods to address the non-normality of market returns, some definitions are in order. Imagine a graph of a sizeable asset class—let's say all U.S. equities—where each data point represents what that company's stock price was at the day's end when the U.S. market closed. The mean (i.e., where the largest number of values lie) of that bell-shaped curve might be right in the middle of that curve with most values within one step away—either a positive or an equally negative step away—from that mean (i.e., the standard deviation).

With a normal distribution, if you were tossing coins, you would have a 50/50 chance of your coin landing with the tail side up or the head side up. Now what would happen if your coin were weighted heavier on the tail side? Your results would be skewed. If you had placed a bet on the tail side appearing upon landing, you would say that the results were negatively skewed like the diagram to the left in Illustration 2. In other words, if you had placed a bet on the tail side appearing upon landing, the odds are that you're going to lose your bet more times than win.

A distribution with negative or positive skewness is not a normal distribution.

Investors do not like negative skewness. Investors love positive skewness, which is shown in the diagram to the right in Illustration 2.

**Illustration 2: Negative and positive skewness**



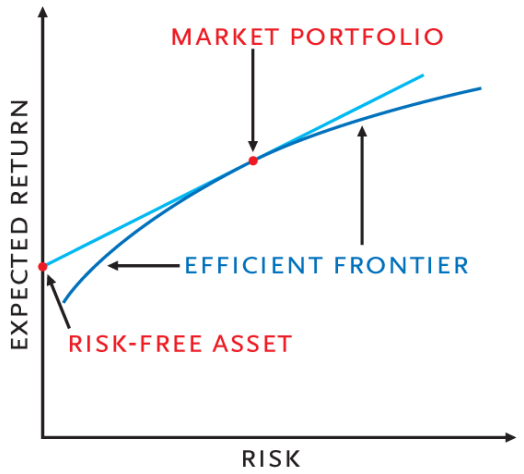

Another fact before visiting the non-normality model view: The Central Limit Theory roughly states that any data that's influenced by many small and unrelated (i.e., independent) random effects is approximately normally distributed. For large financial markets, like all U.S. equities, where each company's return is usually influenced by many small and unrelated impacts, a normal distribution holds true enough to form useful investment models that can then forecast what future equity return outcomes are likely to occur, with certain known levels of confidence in those forecasts.

An interesting statistically proven (albeit counterintuitive) aspect of The Central Limit Theory is that if you're only using a sample (in this case, not all the data from all the U.S. equities' returns) that's greater than 30 members, even if the entire population (e.g., all the U.S. equities' returns) is NOT normally distributed, your sample approaches a normal distribution.

In the early 1950s Harry Markowitz added an additional piece to modern portfolio management. Markowitz's mean-variance theory is captured

quite neatly in Illustration 3's mean-variance diagram. This graph refines mathematically the concept of diversification by letting the forecasted mean (or average return) of an asset represent the expected return of an asset and the expected standard deviation represent the risk of not receiving that expected return. The line labeled the efficient frontier consists of all those investment portfolios (i.e., baskets of assets whose return behaviors are not related to similar factors—they don't react the same to different variables like interest rate changes, consumer behaviors, etc.) for which the expected return is the highest for any level of risk and the risk the lowest for any level of expected return.

**Illustration 3: Markowitz Mean-Variance**

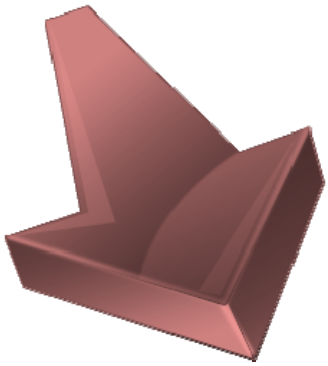



The theory states that an individual will always choose a basket of assets sitting on this line because they want to get the most return for the amount of risk that they're willing to bear.

Markowitz assumes that: future asset class returns are normally distributed and independent (i.e., not related), the investor only cares about risk/reward, and the investor is rational. With refinements from various different experts (one example: Drs. Richard and Robert Michaud's Resampled Efficient Frontier™ resampling optimization process), Markowitz's theory is still the basis of most contemporary asset management models.

In his May 23, 2006 presentation at the CFA Institute's International conference, IMB's UBS Chair in Banking and Finance and Director of Strategic Finance Professor Didier Cossin showed that in past recent crises, the majority of asset classes that were previously unrelated became related. In other words, no matter what asset class you held except most cash, its value fell in response to the crisis—(i.e., correlation converged to one). Cossin also noted that during these events, liquidity evaporated for some time period during and after the event.

For instance, if you had a sample basket of usually unrelated assets prior to the Fall of 2008, your basket probably had a normal distribution. If you wanted to sell an asset from that basket, you could because there was a high probability that you could find a buyer (i.e., the market was liquid). From the onset of the Fall of 2008, however, all the assets that weren't previously related began to act in the same manner (i.e., downwards). Furthermore, you were stuck with those assets because there were no buyers (illiquid market).



In the Fall of 2008, most asset classes became correlated and liquidity evaporated. The underlying assumptions supporting a normal distribution no longer existed and investors experienced negative skewness, a big fat left tail.

## NON-NORMAL MODEL PROPONENTS

In his December 2008 article, *Tail Risk Management: Why Investors Should Be Chasing Their Tails,* Dr. Vineer Bhansali, PIMCO's Managing Director and head of analytics for portfolio management, recommended hedging tail risk, such as by buying "downside hedges on equities and credit, for example." If those options are too expensive, he recommended changes in the modeling to account for non-normal probability distributions by "lowering exposure to assets, such as equities and corporate bonds that carry a higher level of risk in the current market environment. At the same time, it might be an attractive opportunity to pick up so-called 'right tail' options, which could have a substantial payoff in the case of a low-probability upside event. For example, purchasing a small amount of distressed credit could potentially benefit the portfolio if the economy were to make an unexpectedly swift rebound."

In their May 2009 white paper entitled *Non-normality of Market Returns: A framework for asset allocation decision-making*, Addullah Z. Sheikh and Hongtao Qiao of J.P. Morgan Asset Management advocated an immediate change from the traditional approach to a revised asset allocation framework that incorporates advanced statistical methods to account for non-normality, such as Conditional Value at Risk ($CVaR_{95}$).

Their recommendation is based upon the following:

1. In the real world, future asset class returns are NOT normally distributed.
2. In reality, many times future asset class returns are not independent from previous returns for that asset class.
3. The shortcomings that existed before when using an asset allocation framework that permits non-normality (namely, the standard deviation then becomes useless as a portfolio risk measure) have been overcome by using the latest statistical methods.
4. The specific source of non-normality in each market event is irrelevant if the impact from the non-normality on downside portfolio risk is captured.
5. The three major categories of non-normality are: serial correlation, fat left tails [i.e., negative skewness and leptokurtosis], and correlation breakdown due to lack of linear relationships.
6. The three major corrections to the standard asset allocation framework that are employed using non-normality are: un-smoothing serial correlation, modeling fat left tails using Extreme Value theory, and applying copulas to model joint distributions where linear relationships don't exist.
7. By capturing the three major categories of non-normality and correcting them via sophisticated statistical tools like $CVaR_{95}$, returns will be more in line with investors' preference to avoid negative losses associated with fat left tails.
8. The downside risk profile for each asset class is different and can't be captured by using traditional modeling techniques or risk measures such as standard deviation.
9. $CVaR_{95}$ captures those unique risk profiles for each asset class, which means that the asset allocation selection will be different using a $CVaR_{95}$ motivated non-normal framework.
10. Therefore, $CVaR_{95}$ is the recommended approach because it's "a better fit for investors' asymmetric risk preferences, as well as the "fat" left tails recognized by non-normal asset allocation frameworks … (plus) an asset allocation incorporating non-normality has the benefit of reducing the need for external constraints."

## REBUTTALS TO NON-NORMALITY

One highly qualified individual to present the counterpoint to the non-normality distribution approach of Bahansali, Sheikh and Qiao, and other non-normality model proponents is Dr. David Esch, Director of Research at New Frontier Advisors LLC. His firm has reworked some of the problems initially confronted when applying Harry Markowitz's theories to real world asset allocation situations, so well that even Markowitz acknowledged some of their improvements.

Dr. Esch has written a paper addressing this topic entitled "Non-Normality Facts and Fallacies," which will soon appear in the *Journal of Investment Management*. Rejecting the notion that normal distributions are flawed, Esch's paper identifies quite specifically how normal distribution models account for non-normal distributions. He then explains in detail the shortcomings of a number of the non-normal financial modeling techniques that are currently gaining popularity.

First and foremost, Esch explains that normal models can easily be used—and are currently used—to account for non-normal return distributions quite effectively even though the normality assumption is violated frequently.

A review of investment management literature dating back into the 1960s confirms that numerous papers have critiqued the normal distribution assumptions (Fama/1965, Rosenberg/1974, Rosenberg and Ohlson/1976, Los/2002, Fuertes, Miffre, and Tan/2005, Adcock and Meade/2006) yet the normal distribution assumption continues to be used.

In their 1996 paper titled *Statistical Applications of the Multivariate Skew-Normal Distribution*, Azzalini and Capitanio explained this phenomenon, **"A major reason for this state of affairs is certainly the unrivaled mathematical tractability of the multivariate normal distribution, in particular its simplicity when dealing with fundamental operations like linear combinations, marginalization and conditioning, and indeed its closure under these operations."** George Box's insight that **"all models are wrong but some are useful"** seems to capture the collective reasoning behind the continuing use of normal distribution models in actual practice.

**David N. Esch, Ph.D.**

Dr. Esch is the Director of Research at New Frontier Advisors LLC (NFA). Starting as a Research Associate at NFA while completing his Ph.D. in Statistics at Harvard University, Dr. Esch has a long history of working on numerous research and statistical projects with NFA's founder Dr. Richard Michaud. He can be contacted through email at www.newfrontieradvisors.com.

According to Esch, this ease of use is enhanced by the normal distribution models' ability to rely on fewer moments (mean and standard deviation are known in statistics as the first and second moments) when analyzing sample data (even small samples). The result: the forecasts emanating from the analysis are usually correct, which is an important feature to consider.

The complexity of the non-normality models, which attempt to extract more parameters and higher moment information (skewness and kurtosis are the third and fourth moments) from the data, tend to extract less pertinent information that leads to a greater overall error rate in their forecasts, states Esch. For instance, outliers in the datasets can wreck havoc on more complex models by causing large sampling errors in the sample skewness and kurtosis. **"Usually in investment application situations, the sample data is simply not enough to consider much more than the first two moments," explains Esch.**

When asked about the better performance achieved by applying Sheikh and Qiao's non-normal framework, Dr. Esch reminded this author that, unlike medicine where experiments can be repeated, Sheikh and Quiao's non-normal performance illustration is but "one instance of reality. Because it's highly unlikely that the exact same scenario will repeat itself, the question remains whether the results gained were from "good luck or good modeling."

Another topic that Esch covers in his article is the newness of the non-normal models, many of which are using experimental approaches that may not produce stable or valid results. One class of non-normal models that is being widely touted is based on Gaussian copulas. Esch's article details the appropriate uses of these copulas and how when these copulas are transformed to non-normal, the validity of the analysis can become compromised and overall error rates increase.

As for Sheikh and Qiao's claim that their quantitative results illustrate that "incorporating non-normality may reduce the portfolio's volatility, improve its efficiency (Sharpe ratio), and reduce its risk relative to unpredictable, extreme negative events," **Dr. Esch states that "there's no conclusive evidence to date"** that can support Sheikh and Qiao's beliefs.

While agreeing with Bhansali, Sheikh and Qiao, and other proponents that investors prefer to avoid negative losses, Dr. Esch's concern is that investors will not realize how much of their returns they will NOT be receiving using non-normal probability distribution models in times when a market crisis is not occurring. The vast majority of research shows that investors have a two-fold interest: avoiding negative losses AND gaining upside returns. **Dr. Esch comments, "Will they [investors] be willing to continue using a strategy that underperforms their peers during times of stability…or will they choose to fire their fund manager for underperformance?"**

Thinking of investors' total profile of wanting the high returns when their peers are earning high returns, but not wanting the often related negative tails during market ebbs, broaches another relevant question:

- Would it be possible to use $CVaR_{95}$ during volatile market periods and then switch the allocations to capture the upside during stable or rising market value timeframes?

In their white paper, Sheikh and Qiao state clearly that market stress and disruptions are rare and unpredictable. Other facts tend to support their

view. For example, such omnipotent individuals and companies as Warren Buffet, the Oracle of Omaha, and Goldman Sachs didn't escape The Fall of '08 unscathed. Buffet's firm lost its coveted triple-A credit rating and Goldman Sachs became a bank needing government support in multiple ways for a time. If these geniuses couldn't move completely out of the path of an avalanche they saw coming, what's the probability of anyone choosing always the right time to switch allocations? Probably very low.

PIMCO's **Vineer Bhansali also confirms** that tail risk is caused by **"events that are relatively rare…[but] these rare events can cause outsized gains or losses for investors."** Esch's article provides some thoughtful analysis of these events, when for a time investors fear that the diversification benefits are disappearing from holding a normally distributed portfolio located on Markowitz's Efficient Frontier. **"It's true that these systemic shocks for a time will produce a large measured correlation close to one," states Esch. "However, there are idiosyncratic risk factors within assets that once the storm has passed will surface again."**

In fact, 2009 has been a perfect case in point: after the storm has subsided, asset values commenced to react differently to the same stimuli…and Buffett and Goldman returned to sizeable profit levels. **Given the impossibility of perfect market timing, Esch counsels, "It remains advisable to be diversified simply because if you're not, you're making active bets, which leave you, the investor, exposed to diversifiable risk. Unless you've got good information behind those bets, it's probably not sensible to make them."**

## CONCLUSION

Tim Kelly, in his article cited earlier, thought that the reason why finance professionals don't seem to get any better at spotting and protecting against developing bubbles is because of "human nature, the complex human psyche, and the myriad of mental shortcuts that we naturally employ when faced with decisions."

In this article, numerous well-respected brilliant minds have quite divergent viewpoints about ways to avoid bubbles and crises. The laissez-faire camp thinks bubbles and crises are impossible to avoid. Another equally distinguished group thinks that the people in charge of Wall Street as well as the regulators are responsible for the bubbles and crises, which could be avoided by better structural oversight.

Yet other groups say that whether or not bubbles and crises can be avoided, the impact from these financially negative events can be mitigated. One faction recommends switching to non-normal distribution models whereas the other says stay with the tried and true normal distribution asset management system that employs the mathematical diversification of Markowitz's mean-variance theory.

**Tim Kelly**

Tim Kelly's article contains an assignment:

"You are asked to complete the following sequence of numbers: 2,4,6 [x]. One heuristical approach may be to interpret the trend as merely increasing each prior number by a constant, in this case 2, so that x equals 8. Another plausible heuristical approach may be to interpret the trend as an additive sequence whereby the first number is added to itself (2+2=4), the resulting number then is added to the prior, and so on. In this manner, x would equal 10. So which one is right?

Who knows? The study of decision making is not how to make the *right* decisions but how to insure that you are making the *best* decisions as defined by the most rational, objective, and well informed ones possible."

Kelly's article, *Decision Making and Market Crises*, is available **here**.

The answer to the question posed by the title of this article, therefore, is: Time will tell. Time will tell whether better structural oversight can prevent future bubbles and crises. Time will tell if non-normal distribution models provide in all periods better returns than the conventional Markowitz approach. Taking the time to assess all viewpoints, all facts, and then considering your own unique capabilities and financial condition will result in you making the best decisions regarding these topics today.

## About the Author

### KATHLEEN A. GRAHAM (graham@hqsearch.com)

- Kathleen "Kathy" Graham is a Principal with HQ Search, Inc., a retained executive search firm specializing in financial services positions globally that she co-founded in 1997. Her clients are asset/money management companies; domestic money center, international, and suburban banks; investment/merchant banks; consulting firms; corporations; credit rating services; pension funds; real estate developers; trading institutions/hedge funds; and private equity/venture capital firms. Kathy focuses on placing talent with base salaries ranging from $100,000 to $1,000,000+. She routinely advises senior management of clientele firms with the latest market intelligence regarding economic conditions, emerging trends, and potential developing hazards to their business in addition to providing significant input into their hiring and marketing strategies.
- Kathy was a first-day keynote presenter at the Chicago Federal Reserve's 2009 Ninth Annual Private Equity Conference. Her topic was how to more effectively use a firm's human capital to improve performance. Kathy also was one of three keynote lunch panelists discussing networking in the investment management industry at the University of Chicago Booth School of Business's 2009 Executive MBA Career Focus Conference.
- At the request of The CFA Society of Chicago, Kathy created a career event, ***Your Career Strategist™***, for their members. This event sold out in 2 hours the first day it was announced. Survey results from attendees: 100% found value in their session and 100% said Graham "provided useful suggestions for modifying their resume" and "formulated a successful career strategy in their field." Kathy has also been a speaker for numerous other local and national finance-related groups, including the Managed Funds Association and Financial Research Associates.
- For the last seven years Graham has issued an annual financial services job forecast, which to date has been completely accurate in forecasting the overall prevailing trends and hot jobs/dud jobs for each finance sector. She also started three new companies in 2006: HQ Seminars, Inc. (custom designed financial niche and in-house seminars); HQ Scripts, Inc. (editing and creation of financial articles, books and newsletters); and HQ Services, Inc. (financial services compensation studies, brainstorming/focus groups).
- Kathy's latest book is ***Graham's Manual of Style for Resumes and Cover Letters***, published in September 2009. Her articles, which have appeared in publications such as *Financial Engineering News* and *Financial History*, include a seminal paper in 2006 predicting the unprecedented changes in the global financial marketplace. Her first children's book, ***The Land of Lemons and Nuts***, published in 2008, teaches economics to children ages four through nine and is available in English, French, and Spanish.
- Graham obtained her MBA in Finance, Analytic Finance, and Econometrics & Statistics from the University of Chicago. She received the University of Chicago's Booth School of Business "CEO" award in 1998, and later for four years was the Global Chair of their alumni Finance Roundtable. She is also an active member of 100 Women in Hedge Funds, the CFA Institute nationally and locally, Chicago Financial Women, Hedge Funds Care, QWAFAFEW, GARP, and PRMIA.