



January 2007

# Northfield News

*A Newsletter for the Friends and Clients of Northfield Information Services*

## **Portfolio Analysis of Investment Funds with Undisclosed Holdings** **By Dan diBartolomeo**

### **Background**

A common problem for institutional investors is the need to analyze the risk and performance of a fund of which the underlying holdings are unknown. This problem is most common with respect to hedge funds that choose not to disclose their holdings to investors, but also arises with traditional mutual funds for which public disclosure of holdings is done infrequently or not in a timely fashion.

At the request of a European client, Northfield created an analytical procedure to deal with such situations. Over the next few months we will be using a more refined version of this procedure and putting it into full production in order to add risk analysis of thousands of hedge funds to the coverage universe of our Everything, Everywhere risk model. The majority of this work is being conducted by Daniel Mostovoy in London.

If we don't have the underlying holdings of a fund, we have to base our analysis on the observed returns of the fund. However, there are a number of problems in returns based analysis that are amplified where hedge funds are concerned. Firstly, return distributions for hedge funds often have high degrees of skew and kurtosis. This makes typical estimation methods (i.e. OLS regressions) for metrics such as beta and alpha unreliable. Some investment firms have tried to measure all moments of the historically observed return distribution (mean, variance, skewness, kurtosis). However, the higher moments typically arise from rare outliers in the historic returns, so historic skew and kurtosis are very weak estimators of future values.

One way to improve the estimation of return distribution parameters is to use Markov Chain Monte Carlo methods. These methods combine randomized Monte Carlo simulations with Bayesian statistics to try to provide more robust estimates of the return distribution. Two papers using this approach have been presented at Northfield's annual June research seminar at Newport. The papers were presented by Jostova and Philipov (2003), and Sfridis (2006). Another simple step to improve estimation of performance metrics derived from historic returns include using non-parametric methods such as mean absolute deviation regression.

Today, the most common approach to analyzing fund returns is the method of returns-based "style analysis" as described in Sharpe (1992). An important aspect of this method of analysis is the selection of the "spanning set" of return indices that are used to mimic the behavior of the subject fund. If we know that a fund invests only in European bonds, we will use a different set of market indices to try to describe the fund's behavior than if we know that the fund is investing in Asian equities. On the other hand, there is ample

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### **Special Points of Interest:**

- ▶ **In Depth Article - Portfolio Analysis of Investment Funds with Undisclosed Holdings**
- ▶ **Northfield Hedge Fund Seminar in Boston**
- ▶ **Northfield Partner Update**
- ▶ **Technical Support Tip: Converting Marginal Variance to Marginal Standard Deviations**

### **Inside This Issue:**

- ▶ **Northfield Annual Conference and Asia Seminar Wrap-Ups**
- ▶ **Northfield European Seminar in London**
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- ▶ **New Staff Member in the Boston Office**
- ▶ **Dan diBartolomeo Appointed Visiting Lecture at Brunel University**

## Recent and Upcoming Events

### 2007 Hedge Fund Seminar

Northfield Offices • Boston, Massachusetts • March 8, 2007

Northfield will be holding a one day Hedge Fund Seminar in our Boston office. The seminar will feature hedge fund specific presentations of topics of importance to our growing number of hedge fund clients. At the conclusion of our workday, we invite our guests to join us for a cocktail reception during a men's doubles semi-final match at the US Open Championships of Court Tennis, the unique medieval game that is the ancestor of all modern racquet sports. The tournament is being held at the Tennis and Racquet Club of Boston.

We are accepting online registrations only. To complete your online registration, and to view the detailed conference agenda, visit <http://www.northinfo.com/events.cfm>. Contact Kathy Prasad if you have any difficulties registering, [kathy@northinfo.com](mailto:kathy@northinfo.com), 617.208.2020.

#### Agenda

The agenda will consist of five presentations.

##### Risk Containment for Hedge Funds

Anish Shah, Northfield Information Services

##### A Market Impact Model that Works.

Dan diBartolomeo and Howard Hoffman, Northfield Information Services

##### Risk Management for Hedge Funds with Undisclosed Holdings

Sandy Warrick and Daniel Mostovoy, Northfield Information Services

##### Positive Hit Rates vs. Return Asymmetry—Does it Matter How Alpha is Achieved

Andrei Pokrovsky, RCG Ardis Capital

##### Hedge Fund Performance Measurement

Dan diBartolomeo and Steve Gaudette, Northfield Information Services

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## Northfield European Seminar

London • April 19, 2007

Northfield will be hosting a one day seminar in London on April 19, 2007. The purpose of the seminar is to showcase research on various topics in investment and risk management to our European clients.

Further details will be posted to <http://northinfo.com/events.cfm> as the venue and agenda become finalized. Contact Northfield's London office for further details, +44-(0)-20-7801-6260, [rupert@northinfo-europe.com](mailto:rupert@northinfo-europe.com), [christine@northinfo-europe.com](mailto:christine@northinfo-europe.com), [david@northinfo-europe.com](mailto:david@northinfo-europe.com) or [george@northinfo-europe.com](mailto:george@northinfo-europe.com).

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## Asia Seminars Wrap-up

Tokyo, Hong Kong and Sydney • November 2006

In November, we hosted our annual Asia Seminar Series with three highly successful events in Tokyo, Sydney and Hong Kong. The seminars showcased our research on key topics in investment and risk management to our growing family of Australian and Far Eastern clients and prospects and broadened awareness of the range and depth of Northfield products, services, and research.

The presentations were given by Northfield President Dan diBartolomeo. Topics included: "Parameter Estimation Error in Portfolio Optimization," "Optimal Turnover and the Single Period Assumption in Portfolio Optimization," "Fat Tails, Tall Tales, Puppy Dog Tails," "Multiperiod Optimization for Private Client Asset Allocation" and "Modeling Direct Owned Real Estate in a Securities Market Framework." Complete seminar proceedings have been posted at <http://www.northinfo.com/papersearch.cfm>.

## 2006 Northfield Annual Research Conference Wrap-up

The Greenbrier • White Sulphur Springs, WV • October 23-25, 2006

Northfield's Annual Research Conference took place at the Greenbrier, in White Sulphur Springs, West Virginia. The Greenbrier was a return to one of Northfield's most memorable venues of 10 years ago. Set in the beautiful Allegheny Mountains, the Greenbrier represents 228 years of history with its classic architecture, exquisite interior design, carefully sculpted landscape, and impeccable service. The Greenbrier was also the site of a former U.S. Government Relocation Facility, commonly known as the bunker, which was to be used by the US Congress in the event of a nuclear war.



The Greenbrier

The conference presented recent research and technical advances to a sold out audience of Northfield clients and friends. The agenda consisted of thirteen presentations. Topics included: "Information Horizon, Portfolio Turnover, and Optimal Alpha Models," "Frontier Markets Investing: What Should a Quant Manager Do?," "Attribution to Active Signals," "The Visual Communication of Quantitative Finance," "Long-Short Portfolio Behavior with Barriers," "Markowitz was Wrong!," "Holistic Asset Allocation for Individuals," "A Geospatial Approach to Modeling Shopping Center Locational Efficiency in the San Francisco Bay Area," "Hedonic Geospatial Risk Model of the San Francisco Bay Area Apartment Market," "Best Practices: A Practitioner's Perspective," "Looking for the Optimal Value Tilt," "Sector-Level Attribution Effects with Compounded Notional Portfolios," and "Global Market Impact: What we know, what we don't know."

As is Northfield tradition, the working sessions were accompanied by a complete recreational and social calendar. The conference started on Sunday evening with the "unofficial" welcome reception which featured dinner and a falconry demonstration.

Monday morning was reserved for recreational pursuits with outings for golf, biking, fly fishing, alpine tower climbing and sporting clay shooting. Monday evening featured the traditional Northfield elegant "black tie" gala. Following dinner, the party kicked into high gear with music, drinks and dancing.

The final evening on Tuesday featured a guided tour of the now defunct bunker with dinner, dancing and a Las Vegas night at the "007 Club" which is located in the bunker. Complete seminar proceedings have been posted at <http://www.northinfo.com/papersearch.cfm>.

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evidence that qualitative descriptions of fund strategies are often misleading, as studied in diBartolomeo and Witkowski (1997), Brown and Goetzmann (1997) and Kim, Shukla and Thomas (2000).

Once we move into the area of hedge funds there are additional complications associated with returns-based analysis. Many hedge funds follow strategies that can produce return distributions with a high degree of negative skew. In such cases, the fund can have years of steady, high returns, eventually terminated by a "blow up" in which an extremely large negative return is experienced. Weisman (2001) presented an analysis of this issue at our Coronado client conference that showed that its possible to estimate the likelihood of a "blow up" based on a return track record.

In a related paper, Bondarenko (2004) shows that for a ma-

jority of hedge funds, the high returns reported arise as economic compensation for investor's bearing blow up risk, rather than demonstrable skill on the part of hedge fund managers. To demonstrate this, he defines a new style factor whose economic payoffs are based on the volatility of stock markets rather than the actual returns. The returns to hedge fund were closely correlated to a "short volatility" factor. Some European researchers have begun to refer to this source of returns as "alternative beta" as distinct from "alpha" (i.e. extraordinary returns arising from manager skill). Harvey and Siddique (2000) provide a detailed analysis of the relationship between average returns and skew in return distributions.

Another commonly used volatility based index is to construct a return series of "long mortgage based securities and short treasury coupon bonds." As borrowers hold the

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option to pay off a mortgage early by refinancing their loan, mortgage securities tend to fall in value when interest rates are volatile, and rise in value when interests are perceived as quiet. The performance difference between mortgage securities and comparable duration treasury securities can then be used as a factor to detect volatility based strategies in fixed income funds. An extensive discussion of which market indices are appropriate in return-based analysis of hedge funds is provided in Fung and Hsieh (2002).

### **Our Approach**

Northfield's approach to modeling funds is to go well beyond returns-based methods. Our effort is to identify a "proxy portfolio" of identifiable securities that represents the mostly likely set of underlying investments for the fund being studied. Our proxy portfolio is not meant to be a guess at the true underlying portfolio, but rather be an efficient estimate of the typical style bets of the fund, the degree of portfolio concentration and the balance between asset specific and factor risks. This allows us to have an appropriate risk measurement proxy for a fund with undisclosed holdings, and to use this proxy portfolio as a representation of the fund in asset allocation procedures.

To identify the maximum likelihood proxy portfolio, we will begin with a returns based style analysis to identify a broad universe of securities that captures broad strategy of the fund. We then use our risk models and optimization technology to find the portfolio of individual securities that best describes all of the properties of the fund's return such as the observed balance between style risks and asset specific risks.

We begin by defining a "style group" (a set of market indices) that we believe appropriate for each different type of hedge fund (market neutral equity, global macro, convertible arbitrage, etc.). Unlike long-only funds, for hedge funds, we need to be able to allow short positions in the portfolio of spanning indices while controlling gearing within rational limits. This is accomplished by allowing the weight on the "cash" asset class within the style analysis to have negative weight, simulating the leverage that hedge funds often employ. Given the potential gearing effects, it is crucial to estimate confidence intervals on the style weights arising from the analysis. Our systems calculate the confidence intervals as derived in Lobosco and diBartolomeo (1997), so as to filter out style weights that are not statistically significant.

Hedge funds may change character more rapidly than traditional funds. We need to employ methods to make the analysis more responsive to behavior changes in the fund

analysis. One approach is to use Kalman filter methods as put forward at our Yosemite client conference by Swinkels, and Van Der Sluis (2001). However, the Kalman filter approach is not tractable in the face of long-only constraints that are a common feature of returns-based analysis.

Instead, we use two techniques to help us address the potential changes in character of hedge funds over time. First, we apply a particular form of CUSUM methods to determine the optimal "look-back" period for the style analysis (i.e. do we want to look at fund style over the last 3 years, 5 years, 32 months, etc.). CUSUM is a statistical process control technique widely used to monitor the quality of industrial processes that was adapted for the purposes of monitoring external asset managers by the IBM pension fund. A detailed description of the methodology was presented in the Northfield client newsletter in February 2005, <http://www.northinfo.com/documents/72.pdf>.

Our second concern is that the fund you are analyzing has recently shifted strategy such that your analysis results of the past are no longer meaningful going forward. Our way to guard against such an occurrence is to run a times-series regression of the fund returns against the returns of the mimicking portfolio of indices. We then do a times series plot of the absolute magnitude of the residuals. If the absolute magnitudes of the residuals on recent data points are larger than the average of the absolute residuals, then the goodness of fit is decreasing as we move toward the end of the data sample. If this slope is positive and statistically significant, then we exponentially weight the data observations to put more emphasis on the more recent observations. This will reduce the recent residuals relative to the average value. The degree of exponential weighting used is the minimum value that prevents the slope from being significantly positive.

By running our very enhanced style analysis, we get three pieces of information: the observed volatility of the subject hedge fund during chosen sample period; the "style" exposures of the subject fund (growth, value, etc.) expressed as percentages of the different indices that best mimic the fund's return behavior over time; and the relative proportion of risk coming from style factors and from asset specific risk.

We can now take the known constituents of our spanning indices and form a portfolio of these constituents weighted by results of the style analysis. For example, if our style analysis said the fund behaved like 50% of the S&P 500 and 50% EAFE, we would form a portfolio that was 50% the weighted constituents of the S&P 500 and 50% EAFE. At this point, we should have a portfolio that has the right

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"style" exposures to match our fund. However, these two indices together have about 1600 stocks and the resulting portfolio would be far too diversified to represent a typical hedge fund. It is likely to have far lower risk than a real hedge fund portfolio, so we need to refine the proxy portfolio. Now we'll consider portfolio volatility. We can load the proxy portfolio into the Northfield Optimizer as both the benchmark and the starting portfolio using our Everything, Everywhere risk model. In this example, our starting portfolio/benchmark would have 1600 stocks. We must reduce the number of positions such that the overall risk of the portfolio approximates the observed risk of the subject fund. We can do this by running an optimization while using the "Maximum number of Assets" parameter. By using a Newton-Raphson type search over "max assets" we can find the revised portfolio that matches the benchmark (and the subject fund) in style, while reducing the diversification to the point where the expected volatility of the proxy portfolio matches the observed volatility of the subject hedge fund.

We now move on to checking the balance between factor and asset specific risks. To accomplish this we load the refined (reduced number of positions) proxy portfolio into the Optimizer as the portfolio with a cash benchmark. By running a risk report, we can determine how much of the expected risk of the refined proxy portfolio arises from factor bets, and how much arises from asset specific risk. If this is a reasonable match to the portion of variance of the subject fund explained by the mimicking portfolio (from the style analysis) we're done. If we find we don't have the appropriate balance between factor and asset specific risks, we can repeat the process of "refining" the proxy portfolio while changing the separate settings for tolerance to factor risk and asset specific risk (the Optimizer RAP coefficients). Again with a search over the relative values of the two parameters, we can find risk acceptance parameter values that bring the relative proportions of factor risk and asset specific risk into line with our analysis of the subject fund.

If we have some information about the past holdings of a fund, such as "the five largest holdings from one year ago," we can form some combination of our proxy portfolio and whatever holdings information is at our disposal to further refine our estimate of what is currently held in the fund.

Once a proxy portfolio is finalized, it can be represented as a composite asset that can be included in the usual fashion in any Northfield risk analysis or optimization exercise. We expect to introduce coverage of a large hedge fund universe within our Everything, Everywhere model as an option for clients during the spring of 2007.

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## Dan diBartolomeo Published in CFA Book

Northfield President Dan diBartolomeo has written a chapter for the recently published CFA Institute book titled "Global Perspectives on Investment Management." Dan wrote the chapter on "Asset Allocation for High Net Worth Individuals." The book will be distributed to the more than 25,000 CFA Charterholders and is available for purchase at the CFA bookstore, [http://www.efastcom.com/CFABookstore/control/productdetails?&item\\_id=070101](http://www.efastcom.com/CFABookstore/control/productdetails?&item_id=070101).

## Technical Support Tip: Converting Marginal Variance (MV) to Marginal Standard Deviations (MSD) By Mike Knezevich (with special thanks to Anish Shah)

### Interpreting Marginal Variance (MV)

Risk calculations are more easily manipulated in variance terms than in standard deviations due to the convenient property of additivity. Within the Northfield optimizer Marginal Variance (MV) numbers are provided as output. These MV numbers approximate the amount by which the tracking variance of a portfolio increases/decreases as the weight of a constituent asset changes.

### For example:

Take for example a portfolio of 100% GE vs. a benchmark composed of 50% GE and 50% IBM. This portfolio has a tracking variance of 61, and IBM has a MV of -204 relative to the portfolio. Let's assume the manager increases the weight of IBM by 1% and funds this purchase by shorting 1% cash (usage of the cash trade is not discussed at this time). The manager's resulting portfolio is now:

	ID	Value
1	*\$\$\$	-1.0000
2	IBM	1.0000
3	GE	100.0000

The post-trade tracking variance for this new portfolio is approximated by adding 1% of the MV for IBM to the tracking variance of the GE portfolio. IBM has a negative MV and will thus decrease the approximated tracking variance of our post-trade portfolio.

Original GE Portfolio Tracking Variance	61.4
MV for 1% increase in IBM	-2.0
Post-Trade Tracking Variance	59.4

### Converting to Marginal Standard Deviation (MSD)

Although mathematically more flexible, variance may be less intuitive due to the units, percentage squared (%<sup>2</sup>). Some practitioners may prefer to use a Marginal Standard Deviation (MSD), also referred to as marginal tracking error, which is stated in more intuitive units of percent. Northfield MV numbers may easily be converted to MSD with some quick calculations.

MV is determined by taking the partial derivative of Tracking Variance (TV) with respect to weight, thus to determine MSD we must take the partial derivative of the Tracking Error (TE) or the square root of the Tracking Variance (TV). Note: Δ is used to describe the partial derivative.

$$\begin{aligned} \text{MSD} &= \text{TV}^{1/2} \\ (\Delta \text{TV}^{1/2}) / \Delta W, \text{ apply chain rule of calculus} \\ \text{MSD} &= (1/2) * V^{-1/2} * \text{MV} \text{ or more simply} \\ \text{MSD} &= \text{MV} / 2 * \text{TE} \end{aligned}$$

The simplified equation reveals that the **marginal standard deviation is the marginal variance of the asset divided by two times the tracking error**. Lets apply this equation to the 100% GE weighted Portfolio and the equal weighted IBM/GE benchmark example from our previous exercise.

- 1) Obtain asset level MV and portfolio TE
  - a) Tracking Error (TE) of the portfolio  
TE = 7.7093

- b) The individual assets MV relative to the portfolio

ID	MV
GE	41.4
IBM	-204.2

- 2) Calculate the Marginal Standard Deviations (MSD) from Tracking Error and MV.

$$\begin{aligned} \text{GE: MSD}_{\text{GE}} &= 41.4 / (2 * 7.7093) = 2.6906 \\ \text{IBM: MSD}_{\text{IBM}} &= -204.2 / (2 * 7.7093) = -13.2455 \end{aligned}$$

### Interpreting MSD:

Similar to the MV, MSD has the property of approximating a change in a portfolio's tracking error with a percentage weight change of a constituent asset.

Let's assume again the portfolio manager purchases 1% of the portfolio value in IBM and shorts a corresponding 1% in cash. The post-trade tracking error is approximated as:

Original GE Portfolio Tracking Error	7.8376
MV for 1% increase in IBM	-0.1325
Post-Trade Tracking Error	7.70515

Compare the approximated post-trade TE with the derived TE for our post-trade portfolio in the optimizer for accuracy.

Total Tracking Variance	59.4337
Tracking Error	7.7093

Although not exact, the approximated TE and derived TE are very similar at 7.70515 and 7.7093 respectively.

Northfield provides MV numbers to approximate an asset's contribution to portfolio risk, numbers which are easily convertible to accommodate different needs or preferences.

For further inquiries, contact Technical Support in Boston: [support@northinfo.com](mailto:support@northinfo.com) or call 617.208.2080. European clients can contact: [support@northinfo-europe.com](mailto:support@northinfo-europe.com) or call +44-(0)-20-7801-6260. In Asia, contact Nick Wade, [nick@northinfo.com](mailto:nick@northinfo.com).

## Northfield Partner Update

### ClariFI™

In October 2006, Northfield partner ClariFI released ModelStation v3. With this new version of ModelStation, the Northfield Open Optimizer is now an option for users to select when constructing their portfolios. The Northfield Risk Models are also integrated into the product. ModelStation is a quantitative investment management platform that integrates all of the vital quantitative processes into a single solution for reduced operational risk, decreased time-to-market and a significant competitive advantage. As an open solution, ModelStation also enables clients to integrate their preferred data sources like FactSet for essential security level information. Please contact your Northfield sales representative or Donovan Goodreau, [dgoodreau@clarifi.com](mailto:dgoodreau@clarifi.com) at ClariFI for more details.

### Instinet

Also in October was the initial release of a trade scheduling tool through Northfield partner Instinet, a global agency broker. The tools, called Wizard (for single trades) and Wizard Pro (for portfolio trades) incorporate the Northfield Open Optimizer and short term risk models and are available through Instinet's Portal and Newport trading platforms. We believe this tool will be a leader in a new generation of trading tools because of its superior execution capabilities compared to volume weighted average pricing (VWAP), its use of a risk management methodology consistent with those used in other phases of the investment process while allowing managers to better manage transaction costs. Please contact Russ Hovanec [russ@northinfo.com](mailto:russ@northinfo.com) at Northfield or [Tom.Whelan@instinet.com](mailto:Tom.Whelan@instinet.com) at Instinet for more details.

## Dan diBartolomeo Appointed Visiting Lecturer

Northfield President Dan diBartolomeo has been officially appointed "Visiting Professor" at the Center for the Analysis of Risk and Optimization Modeling Applications (CARISMA) at Brunel University in West London. The mission of the center is to be a center of excellence recognized for its research and scholarship in the analysis of risk, optimization modeling, and the combined paradigm of risk and return quantification. Visit their website at <http://carisma.brunel.ac.uk/> for more information.

## Northfield Staff Speaking Engagements

Northfield President Dan diBartolomeo spoke at three Factset Conferences in November in Sydney, Hong Kong and Tokyo. The topic for all three was "Applications of Portfolio Variety," which describes the cross-sectional dispersion of security returns within a market. Dan also wrote a paper on this which will be a chapter in an upcoming investment textbook, edited by Knight and Satchell.

Dan presented "Market Impact and Optimal Trade Scheduling," At the University of Tokyo Advanced Finance Seminar series. He presented on this same topic at the University of Connecticut on December 8th.

At the annual meeting of the Modern Portfolio Theory Forum of Japan, Dan presented "Incorporating Option Implied Volatility into Models of Security Covariance." This presentation is based on a chapter Dan wrote in the textbook "Linear Factor Models in Finance," edited by Knight and Satchell.

On December 13, Dan spoke at the UMA Conference in New York. The topic was "A Radical Proposal for the Operation of Multi-Manager Investment Funds." This paper can be found at <http://www.northinfo.com/documents/61.pdf>.

At the upcoming FRA Performance Measurement and Attribution Analysis conference in Miami on April 13, Dan will be presenting "Attribution to the Efficiency of Portfolio Construction." Visit <http://www.frallc.com/conference.aspx?ccode=B460> for more information.

## Anish Shah Rejoins Northfield

We are pleased to announce that Anish Shah has rejoined Northfield after 6 years away in industry and academia. Most recently, he was researching image inpainting (synthesizing missing sections of an image using information contained in the visible part) at Brown. At Northfield, he is researching and improving the mathematical and statistical techniques used in our products. Anish is a CFA charterholder, holds M.S. degrees in Operations Research from The University of California at Berkeley and in Applied Math from Brown University, and is ABD in Brown's PhD program in Applied Math. Anish can be reached at [anish@northinfo.com](mailto:anish@northinfo.com).

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