



March 2013

# Northfield News

A Newsletter for the Friends and Clients of Northfield

## The Volatility of Financial Assets Behaving Badly The Example of the High Yield Bond Market

By Dan diBartolomeo

The most common metric of financial asset risk is the volatility or standard deviation of return. The popularity of standard deviation arises from two very different bases. The first is that standard deviation is the most widely used and understood statistical measure of the *dispersion of a possible set of outcomes around the expected value of the outcome* (in this case, the future returns of an asset).

The second is that the long term wealth accumulation arising from investment is related to the geometric mean return, but when we typically discuss statistical distributions of anything we measure the arithmetic mean. The difference between the geometric mean and the arithmetic mean is typically equal to one-half the square of the standard deviation (variance).

However, the legitimacy of both uses of standard deviation as a measure depends on the validity of underlying assumptions about the distribution being described. Typically,

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## Important Information Regarding Upcoming Model and Analytical System Releases

By Dan diBartolomeo

In March and April of 2013, Northfield will be releasing to clients a large number of enhancements to our analytical models services and systems. While all of the upcoming changes have been discussed in previous newsletter articles and documentation releases, this article is intended to summarize all the relevant information in a single discussion.

### Analytical Changes in the 3<sup>rd</sup> Generation Risk Models

Effective with the data release of March 31, 2013, all clients will be receiving data for our 3<sup>rd</sup> generation risk models. In general, the changes are subtle and do not impact the general level of risk expectations associated for any particular portfolio. Most of the improvement will relate to assessments of optimized portfolios.

The largest changes occur in the Global Equity Model, where the factor and sector structure has been revised to better reflect current status of equity markets around the world. The estimation procedures for factor exposures for all time series models (Global Equity and "Single Market" equity models) have been improved to provide more accurate factor exposures at the individual security level. In the US Fundamental Model, a relatively subtle change has been made to the method by which security specific risk is estimated to make the method more consistent with our other models. The structure of the US Macroeconomic model has been revised to include the "principal components in re-

*(Systems, Continued on page 9)*

### Special Points of Interest:

- ▶ **Main Article: The Volatility of Financial Assets Behaving Badly**
- ▶ **New Model and System Releases**
- ▶ **Tech Tip: Horizon Blending**



### Inside This Issue:

- ▶ **Newport Seminar Announcement**
- ▶ **Global Mutual Funds Coverage now Available**
- ▶ **Recent Events and Webinars**

## Upcoming and Recent Events

### 2013 Newport Annual Summer Seminar

Tennis Hall of Fame • Newport, Rhode Island • June 7, 2013

Northfield's Annual Summer Seminar will be held at the International Tennis Hall of Fame in Newport, Rhode Island on June 7, 2013. The purpose of the seminar is to present recent research and technical advances to our clients and friends. Our meeting date has been selected to coincide with the US Professional Championships of Court Tennis. Following the day's presentations, there will be a Court Tennis demonstration by Northfield President Dan diBartolomeo, and then a Court Tennis match. Court Tennis, or "real tennis" is the medieval sport that is the progenitor of all modern racquet sports. After tennis, there will be a relaxing oceanfront dinner party at The Chanler, on the Cliff Walk in Newport.

There is no charge for participation in any aspect of this event, however, we will be accepting donations on behalf of the Pine Street Inn, Boston's largest homeless shelter. The full seminar agenda and registration information will be posted to [www.northinfo.com/events.php](http://www.northinfo.com/events.php) as it becomes available.

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### Attilio Meucci's Advanced Risk and Portfolio Management Bootcamp

August 12-17, 2013 • New York University • New York City

40 CE units CFA Institute, 40 CPE units GARP

The course provides in-depth understanding of buy-side quantitative modeling from the foundations to the most advanced statistical and optimization techniques, with theory, live simulations, review sessions, and exercises. Topics include portfolio construction, factor modeling, copulas, liquidity, risk modeling, and much more.

Visit <http://www.symmys.com/arpm-bootcamp> to register, and view the detailed program information. There is a discounted Northfield partner rate available. A short video is also available: <http://www.youtube.com/watch?v=BUngjNxBWk>

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### Webinar Wrap-up: Liquidity Planning Tools and Strategy Capacity for Equity Markets

January 23, 2012

Northfield President Dan diBartolomeo hosted a webinar on January 23<sup>rd</sup> where he discussed the liquidity shortages during the Global Financial Crisis and the need for both asset managers and institutional investors to have well articulated liquidity policies as part of their strategic investment planning.

The presentation slides are available at <http://www.northinfo.com/documents/545.pdf>. Contact your Northfield Sales Representative if you are interested in viewing the full presentation recording of the event.

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### Northfield Staff Speaking Engagements

On March 8<sup>th</sup>, Northfield President Dan diBartolomeo spoke at the MIT Investment Symposium. The topic was on News Analytics for Risk Analysis.

On April 9<sup>th</sup>, Dan will be at Harvard University where he will be presenting "Quantitative Investing as a Liberal Art."

On March 11<sup>th</sup>, Northfield's Louis Scott was a guest lecturer at the University of Warwick, in Coventry, UK. The topic was "Risk and Forecast models under a crisis."

Northfield's Emilian Belev will be at the Society of Actuaries/PRMIA ERM Symposium on April 23<sup>rd</sup>, in Chicago, IL., where he will be presenting his recent paper "Sovereign Credit and Bank Risk."

### Global Mutual Fund Data Now Available

Northfield would like to announce further extensions of coverage for our risk models. Effective in early November 2012, an optional data set for our Everything, Everywhere model providing coverage on almost all US open-end mutual funds became available. Effective in April 2013 we will be extending this coverage for Global Mutual funds which are based on the Lipper Universe. Please contact your Northfield Sales Representative for further details.

*(Volatility, Continued from page 1)*

we assume that the process is a “random walk,” resulting in asset returns that are normally distributed, have a consistent mean and volatility, and no serial correlation (“i.i.d”, or independently and identically distributed). For most asset classes, when we look at returns measured over holding periods of quarters of years or longer, formal statistical tests would not usually reject the hypothesis that a random walk is a sufficiently good description of the return process. However, for almost all asset classes we would reject the hypothesis of a random walk process when we measure returns over short periods such as days as most distributions appear to have “fat tails” when extreme events are much more frequent than expected (although generally still rare). For an extensive discussion of this issue see diBartolomeo (2007).

One asset class that clearly shows “bad behavior” is the high yield bond market. Even at the broad market index level, the historically observed distribution of returns has properties that make risk assessment in terms of standard deviation a rather subtle task. One might reasonably argue that currently a “good estimate” for the annual standard deviation of return to the high yield bond market could range from around 5% to more than 12% depending on what degree of sophistication we wish to impart to our analysis. As the basis of our empirical analysis we will use the monthly return history of the Barclay’s (formerly Lehman) from July 1, 1983 to December 31, 2012, a span of near thirty years.

If we look at the distribution of the monthly returns for the 356 months of data we get the following summary statistics:

**Summary Statistics**

|          |          |
|----------|----------|
| Mean     | 0.794387 |
| StDev    | 2.507523 |
| Median   | 0.9785   |
| Skew     | -0.94826 |
| Kurtosis | 8.428941 |
| AvgDev   | 1.612903 |

Of particular note is the clear evidence of higher moments. The distribution has negative skew (more downside than upside) which should be intuitive for a high yield bond, as the bond either pays the expected stream of cash flow or defaults. The distribution also has a high degree of kurtosis or fat tails, as compared to the normal distribution (kurtosis of a normal = 3). If we make the usual “normal and i.i.d.” assumptions, we can annualize the standard deviation by multiplying the monthly value by the square root of twelve, for an annualized value of 8.69. If we asked most market participants for an estimate of the volatility of the returns to this high yield bond index, some value close to 8.69 would be a usual response.

However, we must now consider what the presence of the higher moments means to how we should go about estimating volatility. One thing we could do is simply use the more “robust” median and mean-absolute deviation measures for the return distribution. When taken one month at a time, these more robust measures suggest higher returns and lower risks.

The most important thing we need is to understand how the large kurtosis value comes about. There are two competing possibilities. The first is that the distribution of returns is permanently non-normal and has some other form of stable distribution such as a T-distribution (with low degrees of freedom) or a Gamma distribution. The other possibility is that each moment in time, the distribution of returns is actually normal but the volatility level varies greatly from time to time, giving high kurtosis to the total sample. To explore this issue, we simply calculated a 12 month rolling volatility (using the same “square root of twelve” annualization) for each possible month within the sample period.

**Distribution of 12 Month Rolling Volatility**

|        |          |
|--------|----------|
| Mean   | 7.047272 |
| Median | 5.503421 |
| Min    | 1.973751 |
| Max    | 28.60367 |

The first thing we should notice is the huge disparity between the minimum value of the 12 month volatility as compared to the maximum value which is roughly fifteen times higher. This suggests kurtosis in the distribution is likely to mostly arise from time variation in the volatility rather than a stable fat tailed distribution, where the standard deviation would roughly stay constant through time. So if it is our intent of our risk forecast to express the central tendency of the volatility through the next twelve months, a value of roughly 5.5 seems most appropriate, far lower than the 8.69 previously calculated.

If we had come to the opposite conclusion that high yield returns were obtained from a fat tailed but stable distribution, we could use the method of Cornish and Fisher (1937) to adjust the mean and standard deviation values to best fit the observed distribution inclusive of higher moments. Another approach would be to consider the impact of skew and kurtosis on the difference between the geometric and arithmetic means of returns as in Wilcox (2003). Given the standard deviation, skew and kurtosis values, we can calculate the value of the standard deviation which would provide the same degree of arithmetic difference between the two forms of the return mean.

*(Volatility, Continued on page 4)*

(Volatility, Continued from page 3)

Some market participants have also argued that the Global Financial Crisis was an event of very rare and extreme proportion, and is unlikely to reoccur in the foreseeable future. To see how this would impact our volatility estimates we simply compute same statistics with the years 2008 and 2009 removed from the sample.

### Summary Statistics (ex 2008-2009)

|          |          |
|----------|----------|
| Mean     | 0.792033 |
| StDev    | 2.061092 |
| Median   | 0.9715   |
| Skew     | -0.42207 |
| Kurtosis | 3.890982 |
| AvgDev   | 1.416005 |

### Distribution of 12 Month Rolling Volatility (ex 2008-2009)

|        |          |
|--------|----------|
| Mean   | 6.227229 |
| Median | 5.245626 |
| Min    | 1.973751 |
| Max    | 18.12535 |

While the magnitude of skew and kurtosis have been reduced, they remain material. With the GFC period removed, the mean and median of the rolling 12 month volatilities values both decline. With the range between the minimum and the maximum still highly asymmetric around the central tendency, the most reasonable value for a randomly selected 12 month period would be the median of roughly 5.25.

So far, we have annualized our monthly-based volatility estimates assuming there is no serial correlation in our data, as would be conceptually consistent with a highly liquid market. In the case of the Barclay's index, this assumption is untrue as the market for high yield bonds is relatively illiquid compared to other traded financial assets. For the sample period, the first-order autocorrelation coefficient is .33 ( $T > 5$ ) and is highly statistically significant. This implies that monthly returns to the index are in fact highly predictable, so the actual uncertainty of investors about what returns will occur in the next monthly period is actually far less than is described by the standard deviation (assumes the process is random). *The real risk is less because we have useful knowledge about what is coming next!*

One can also make a counter argument. Lo, Getmansky and Makarov (2004) argues that for financial markets to operate rationally, they should not be predictable so the financial benefit of any predictability must be offset by trading costs. To the extent that trading costs inhibit trading, the changes in observed market prices will lag their true economic values so the volatility we calculate from the return data will understate the true volatility. To correct for the degree of autocorrelation in the Barclay's index data, we would need to increase the volatility estimate by 27%.

One way to further illustrate this "liquidity driven" dichotomy would be to consider the case of an investor who is aware of the predictability of high yield returns, but decides to trade in or out of the market only once per year no matter what in order to limit possible trading costs. To estimate we simply calculate *annual returns* from one month end to a year later within the sample period. The volatility (standard deviation) of overlapping 12 month returns is 12.63% for the full sample and 10.15% for the sample without the 2008-2009 period. Note that both of these values are larger than the 8.69% value we got originally with our basic sample. This is illustrative of the strong influence of the serial correlation on and the potential high risks that will be encountered by investors who try to "ride out the storm" in the event of a downward trend in returns.

It should be noted that the degree of liquidity related impact on risk estimation is dependent on the size of the investment portfolio and the likelihood that the investor will decide to exit the market and liquidate all or part of the portfolio. As such, we recommend that investors have a designated liquidity policy for every portfolio and that "liquidity adjusted" risk measures consistent with the prescribed policy be calculated on a portfolio specific basis.

### References

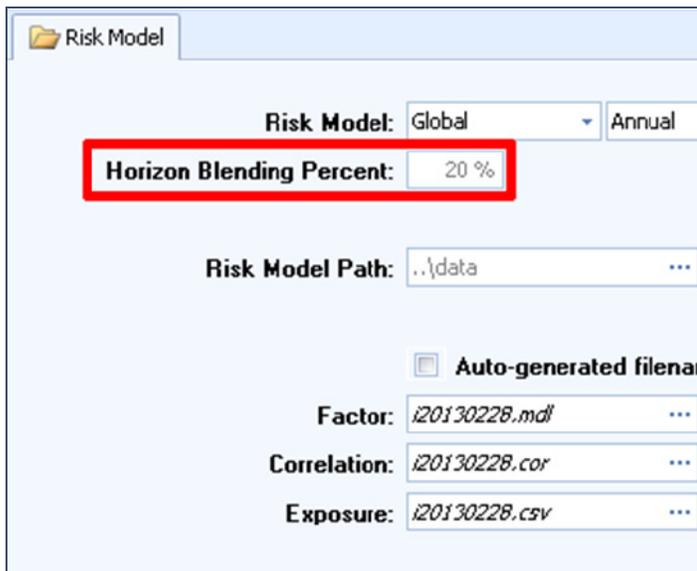
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## Technical Support Tip: Horizon Blending

By Steve Dyer

In the new version of the Optimizer, released in conjunction with the 3<sup>rd</sup> Generation risk models, clients will now have the option of blending the risk estimates of the monthly models with the Adaptive Near Horizon models, which incorporates information about the most recent market conditions. All subscribers to the monthly models will receive the corresponding Near Horizon risk model files for the date on which the monthly model is updated (For more information about the Near Horizon Models, please see <http://northinfo.com/documents/356.pdf>).

The screen shot below illustrates the new Horizon Blending input field, which allows the user to specify the weighting of the Near Horizon forecast to use.



Internal studies indicate the 1 year risk forecasts materially improved by blending in the Near Horizon forecasts. The degree of improvement was relatively similar between a 20% and a 35% weight on the near horizon forecast. This test period included some of the most volatile periods of the century unlikely to be frequently repeated, thus we conservatively opted for the low end of the range as the default. This expanded offering allows clients to shorten their investment time horizon.

As a result of these new features, users may notice, for example, factor variances in the model file differs from the factor variance in the Risk Decomposition reports.

| Factor - [f20130131.mdl] |        |                   |       |          |
|--------------------------|--------|-------------------|-------|----------|
|                          | Factor | PortExp           | Alpha | Variance |
| 1                        | BETA   | Beta              | 0.000 | 406.952  |
| 2                        | E/P    | Earnings/Price    | 0.000 | 2.502    |
| 3                        | B/P    | Book/Price        | 0.000 | 13.107   |
| 4                        | YIELD  | Dividend Yield    | 0.000 | 4.635    |
| 5                        | TRADE  | Trading Activity  | 0.000 | 5.548    |
| 6                        | RST    | Relative Strength | 0.000 | 32.673   |
| 7                        | CAP    | Log of Market Cap | 0.000 | 5.992    |

| Risk Decomposition |                   |         |          |           |           |
|--------------------|-------------------|---------|----------|-----------|-----------|
| Initial Portfolio  |                   |         |          |           |           |
|                    | Factor            | PortExp | BenchExp | ActiveExp | FactorVar |
| 1                  | Beta              | 0.8850  | 1.0407   | -0.1557   | 329.5252  |
| 2                  | Earnings/Price    | 0.8650  | 0.3486   | 0.5164    | 2.1488    |
| 3                  | Book/Price        | -0.7300 | -0.3041  | -0.4259   | 11.2575   |
| 4                  | Dividend Yield    | 0.5350  | 0.2453   | 0.2897    | 4.7420    |
| 5                  | Trading Activity  | 0.9350  | -0.0244  | 0.9594    | 4.7653    |
| 6                  | Relative Strength | -0.5700 | 0.0523   | -0.6223   | 28.0621   |
| 7                  | Log of Market Cap | 3.3400  | 2.1725   | 1.1675    | 5.1468    |

In this article, we will illustrate how blending is incorporated mathematically into the Optimizer’s calculations of factor and stock specific tracking variance.

For these calculations, let’s take for an example project optimizing an equal-weighted portfolio of AAPL and MSFT against the S&P 500 using the January 31, 2013 Fundamental Model data. An abbreviated number of factors are shown for demonstration purposes. This methodology was discussed in the June 2010 article, “Calculating Risk Using Northfield Flat Text Files,” which is available for download at (<http://northinfo.com/Documents/348.pdf>).

For the blending, we let

- F = (k × k) covariance matrix
- σ<sup>2</sup> = (length n) stock specific variances
- c = (scalar) fraction of short horizon

$$(1) F_{\text{blended}} = c * F_{\text{near horizon}} + (1-c) F_{\text{monthly}}$$

$$(2) \sigma^2_{\text{blended}} = c * \sigma^2_{\text{near horizon}} + (1-c) \sigma^2_{\text{monthly}}$$

Let us first address equation (1) by calculating the covariance matrices for both the Near Horizon and Monthly data.

Tech Tip, Continued from Page 5

- Determine the active factor exposures of the portfolio. This is simply the sum of each asset's weight in the portfolio multiplied by the asset's factor exposure, and is the same for the monthly and near horizon:

| Factor            | AAPL       | MSFT        | PortExp  |
|-------------------|------------|-------------|----------|
| Beta              | .09        | 0.87        | 0.8850   |
| Earnings/Price    | 1.23       | 0.5         | 0.8650   |
| Book/Price        | -0.8       | -0.66       | -0.7300  |
| Dividend Yield    | (.5)× 0.31 | +(.5)× 0.76 | = 0.5350 |
| Trading Activity  | 2.06       | -0.19       | 0.9350   |
| Relative Strength | -0.47      | -0.67       | -0.5700  |
| Log of Market Cap | 3.55       | 3.13        | 3.3400   |

Apple has a beta of 0.9 and Microsoft has a beta of 0.87, so the portfolio beta is:

$$[(0.5 \times 0.9)_{AAPL} + (0.5 \times 0.87)_{MSFT}] = 0.8850$$

- Determine the active factor exposures of the portfolio in the same manner.
- Calculate the active factor exposures, which is the portfolio exposure minus benchmark exposure:

| Factor            | PortExp | BenchExp | ActiveExp     |
|-------------------|---------|----------|---------------|
| Beta              | 0.885   | 1.041    | -0.156        |
| Earnings/Price    | 0.865   | 0.349    | 0.516         |
| Book/Price        | -0.73   | -0.304   | -0.426        |
| Dividend Yield    | 0.535   | -        | 0.245 = 0.290 |
| Trading Activity  | 0.935   | -0.024   | 0.959         |
| Relative Strength | -0.57   | 0.052    | -0.622        |
| Log of Market Cap | 3.34    | 2.173    | 1.167         |

- Next create the covariance matrix by combining the factor variance vector with the factor correlation matrix.

- First, take the square root of the factor variance vector in the model file to get the factor standard deviation vector (FacSTD). In the monthly model, this is the .mdl file:

**MONTHLY**

| Factor            | FactorVar | FacSTD |
|-------------------|-----------|--------|
| Beta              | 406.952   | 20.2   |
| Earnings/Price    | 2.50187   | 1.58   |
| Book/Price        | 13.1071   | 3.62   |
| Dividend Yield    | 4.63472   | 2.15   |
| Trading Activity  | 5.54828   | 2.36   |
| Relative Strength | 32.6727   | 5.72   |
| Log of Market Cap | 5.9924    | 2.45   |

and the .mbw file for the Near Horizon model:

| NEAR HORIZON      |           |        |
|-------------------|-----------|--------|
| Factor            | FactorVar | FacSTD |
| Beta              | 19.818    | 4.45   |
| Earnings/Price    | 0.73662   | 0.86   |
| Book/Price        | 3.85908   | 1.96   |
| Dividend Yield    | 5.17129   | 2.27   |
| Trading Activity  | 1.63356   | 1.28   |
| Relative Strength | 9.61972   | 3.1    |
| Log of Market Cap | 1.76432   | 1.33   |

- The same correlation matrix is used for both the monthly and Near Horizon, which is the .cor file:

**Correlation Matrix**

| Factor | BETA  | E/P    | B/P    | YIELD  | TRADE  | RST    | CAP    |
|--------|-------|--------|--------|--------|--------|--------|--------|
| BETA   | 1.000 | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  | 0.000  |
| E/P    | 0.000 | 1.000  | -0.067 | -0.073 | -0.227 | 0.065  | 0.162  |
| B/P    | 0.000 | -0.067 | 1.000  | 0.170  | 0.123  | -0.014 | 0.185  |
| YIELD  | 0.000 | -0.073 | 0.170  | 1.000  | -0.147 | 0.112  | 0.181  |
| TRADE  | 0.000 | -0.227 | 0.123  | -0.147 | 1.000  | 0.099  | -0.292 |
| RST    | 0.000 | 0.065  | -0.014 | 0.112  | 0.099  | 1.000  | 0.135  |
| CAP    | 0.000 | 0.162  | 0.185  | 0.181  | -0.292 | 0.135  | 1.000  |

- Construct the covariance matrix by multiplying the factor standard deviation vector by the correlation matrix and the factor standard deviation. Shown below are the steps to calculate the covariance matrix column for the Earnings/Price factor.

Multiply the **factor standard deviation for each factor** (FacSTD(i)) by the correlation of the factor with E/P (corr(i,E/P)), then by the **factor standard deviation of E/P** (FacSTD(E/P))

| Factor | Fac STD(i) | * | corr (i,*E/P) | * | FacSTD (E/P) | = | CovM (E/P) |
|--------|------------|---|---------------|---|--------------|---|------------|
| BETA   | 20.173     | * | 0             | * | 1.582        | = | 0.00       |
| E/P    | 1.582      | * | 1             | * | 1.582        | = | 2.50       |
| B/P    | 3.620      | * | -0.067        | * | 1.582        | = | -0.38      |
| YIELD  | 2.153      | * | -0.073        | * | 1.582        | = | -0.25      |
| TRADE  | 2.355      | * | -0.227        | * | 1.582        | = | -0.85      |
| RST    | 5.716      | * | 0.065         | * | 1.582        | = | 0.59       |
| CAP    | 2.448      | * | 0.162         | * | 1.582        | = | 0.63       |

Calculating each factor for the monthly model and the Near Horizon model, resulting in the following covariance matrices. The diagonal contains the factor variances since each factor is perfectly correlated with itself, while the off-diagonal contains covariance between the factors:

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Tech Tip, Continued from Page 6

**MONTHLY**

| Factor | BETA   | E/P   | B/P   | YIELD | TRADE | RST   | CAP   |
|--------|--------|-------|-------|-------|-------|-------|-------|
| BETA   | 406.95 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| E/P    | 0.00   | 2.50  | -0.38 | -0.25 | -0.85 | 0.59  | 0.63  |
| B/P    | 0.00   | -0.38 | 13.11 | 1.33  | 1.05  | -0.29 | 1.64  |
| YIELD  | 0.00   | -0.25 | 1.33  | 4.63  | -0.75 | 1.38  | 0.95  |
| TRADE  | 0.00   | -0.85 | 1.05  | -0.75 | 5.55  | 1.33  | -1.69 |
| RST    | 0.00   | 0.59  | -0.29 | 1.38  | 1.33  | 32.67 | 1.89  |
| CAP    | 0.00   | 0.63  | 1.64  | 0.95  | -1.69 | 1.89  | 5.99  |

**NEAR HORIZON**

| Factor | BETA  | E/P   | B/P   | YIELD | TRADE | RST   | CAP   |
|--------|-------|-------|-------|-------|-------|-------|-------|
| BETA   | 19.82 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| E/P    | 0.00  | 0.74  | -0.11 | -0.14 | -0.25 | 0.17  | 0.18  |
| B/P    | 0.00  | -0.11 | 3.86  | 0.76  | 0.31  | -0.09 | 0.48  |
| YIELD  | 0.00  | -0.14 | 0.76  | 5.17  | -0.43 | 0.79  | 0.55  |
| TRADE  | 0.00  | -0.25 | 0.31  | -0.43 | 1.63  | 0.39  | -0.50 |
| RST    | 0.00  | 0.17  | -0.09 | 0.79  | 0.39  | 9.62  | 0.56  |
| CAP    | 0.00  | 0.18  | 0.48  | 0.55  | -0.50 | 0.56  | 1.76  |

5. With the covariance matrices  $F_{near\ horizon}$  and  $F_{monthly}$ , create the blended covariance matrix as in Equation (1) above. The default blending is 20%. The blended covariance matrix is defined as:

$$F_{blended} = (0.2 \times F_{near\ horizon}) + (0.8 \times F_{monthly})$$

Following the purple values in the covariance matrices above, we get

$$F_{blended} (Beta, Beta) = (0.2 \times 19.82) + (0.8 \times 406.95) = 329.52$$

**BLENDED**

| Factor | BETA   | E/P   | B/P   | YIELD | TRADE | RST   | CAP   |
|--------|--------|-------|-------|-------|-------|-------|-------|
| BETA   | 329.53 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| E/P    | 0.00   | 2.15  | -0.33 | -0.23 | -0.73 | 0.51  | 0.54  |
| B/P    | 0.00   | -0.33 | 11.26 | 1.21  | 0.90  | -0.25 | 1.41  |
| YIELD  | 0.00   | -0.23 | 1.21  | 4.74  | -0.68 | 1.26  | 0.87  |
| TRADE  | 0.00   | -0.73 | 0.90  | -0.68 | 4.77  | 1.14  | -1.45 |
| RST    | 0.00   | 0.51  | -0.25 | 1.26  | 1.14  | 28.06 | 1.62  |
| CAP    | 0.00   | 0.54  | 1.41  | 0.87  | -1.45 | 1.62  | 5.15  |

With the blended covariance matrix, calculate factor tracking variance contributions.

1. Multiply the transpose of the active exposure vector by the factor covariance matrix and the active exposure vector: (See Blended Table Below)
2. Add the factor variance and covariance across rows to determine the factor variance contribution, as found in the Risk Decomposition report. (Please note that the ellipses represent the factors that are not represented in these examples; the factor variance contribution in the final column is the actual value using all of the factors in the Fundamental model).

Summing the factor variance contributions gives the factor tracking variance of 64.749. (See 2nd Table Below)

(Tech Tip, Continued on page 8)

**Blended**

|       | Active Exp |   | Covariance Matrix |       |       |       |       |       |       |      | Active Exp |  |
|-------|------------|---|-------------------|-------|-------|-------|-------|-------|-------|------|------------|--|
| BETA  | -0.1557    |   | 329.53            | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00 | -0.1557    |  |
| E/P   | 0.516      |   | 0.00              | 2.15  | -0.33 | -0.23 | -0.73 | 0.51  | 0.54  |      | 0.516      |  |
| B/P   | -0.426     |   | 0.00              | -0.33 | 11.26 | 1.21  | 0.90  | -0.25 | 1.41  |      | -0.426     |  |
| YIELD | 0.290      | X | 0.00              | -0.23 | 1.21  | 4.74  | -0.68 | 1.26  | 0.87  | X    | 0.290      |  |
| TRADE | 0.959      |   | 0.00              | -0.73 | 0.90  | -0.68 | 4.77  | 1.14  | -1.45 |      | 0.959      |  |
| RST   | -0.622     |   | 0.00              | 0.51  | -0.25 | 1.26  | 1.14  | 28.06 | 1.62  |      | -0.622     |  |
| CAP   | 1.167      |   | 0.00              | 0.54  | 1.41  | 0.87  | -1.45 | 1.62  | 5.15  |      | 1.167      |  |

|       | BETA | E/P   | B/P   | YIELD | TRADE | RST   | CAP   | ... | FacContr   |
|-------|------|-------|-------|-------|-------|-------|-------|-----|------------|
| BETA  | 7.98 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  | ... | 7.98489    |
| E/P   | 0.00 | 0.57  | 0.07  | -0.03 | 0.04  | -0.16 | 0.32  | ... | 0.3531     |
| B/P   | 0.00 | 0.07  | 2.04  | -0.15 | 0.04  | -0.07 | -0.70 | ... | 3.61198    |
| YIELD | 0.00 | -0.03 | -0.15 | 0.40  | 0.02  | -0.23 | 0.29  | ... | = -0.38253 |
| TRADE | 0.00 | -0.36 | -0.37 | -0.19 | -0.54 | -0.68 | -1.62 | ... | -1.21299   |
| RST   | 0.00 | -0.16 | -0.07 | -0.23 | 0.08  | 10.87 | -1.18 | ... | 9.23029    |
| CAP   | 0.00 | 0.32  | -0.70 | 0.29  | 0.20  | -1.18 | 7.01  | ... | 5.20177    |

64.749

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Next we address Equation (2), which is the blending the stock-specific variance. Stock specific variance is assumed to be uncorrelated with the factors or other assets. For example, the correlation between (AAPL,MSFT) = 0. The matrix contains a diagonal of stock specific risk with zeroes on the off diagonals. This simplifies the calculation as we can easily add the weighted portion of stock specific risk across assets. The specific risk for each asset is in the 5th column of the exposure file (.csv) for the monthly model and in the 2nd column of the residual risk file (.rbw) for the Near Horizon model.

1. Square the active weight for each asset.

$$\text{ActiveWt}^2 = (\text{PortWt} - \text{BnWt})^2$$

| ID   | Name      | Port Wt | Bn Wt | Active Wt | Active Wt <sup>2</sup> |
|------|-----------|---------|-------|-----------|------------------------|
| AAPL | Apple     | 0.500   | 0.031 | 0.469     | 0.220                  |
| MSFT | Citigroup | 0.500   | 0.017 | 0.483     | 0.234                  |

2. The stock specific risk column in the .csv and .rbw files (Resid) is provided as a *monthly* standard deviation and must be converted into annualized variance.

$$\text{ResidVar} = 12 * \text{Resid}^2$$

We now apply Equation (2) to calculate the blended residual variance, ResidVar<sub>blend</sub> (See Table Below):

$$(2) \sigma^2_{\text{blended}} = c * \sigma^2_{\text{near horizon}} + (1-c) \sigma^2_{\text{monthly}}$$

3. Stock specific variance contribution is:

$$\text{VarContr} = \Sigma(\text{ActiveWt}^2 * \text{ResidVar})$$

Summing the stock specific variance contributions gives us the stock specific tracking variance of 259.468.

Add the Factor Tracking Variance and Stock Specific Variance to get the Total Variance. Take the square root of the Total Variance to get the tracking error of 18.09, as shown in the Optimization Summary below:

| Optimization Summary |         |         |
|----------------------|---------|---------|
| Factor               | Initial |         |
|                      | Return  | Risk(v) |
| Factor               | 0.00    | 65.75   |
| Stock Specific       | 0.00    | 261.62  |
| Total                | 0.00    | 327.37  |
| Tracking Error       |         | 18.09   |
| Portfolio Utility    |         | -3.77   |

The incorporation of the most recent market information into our risk forecasts reflects Northfield’s commitment to robust and rigorous analytics while maintaining openness and flexibility for our clients. For further questions about new Horizon Blending offerings, please contact support at [support@northinfo.com](mailto:support@northinfo.com) or (617) 208-2087.

| MONTHLY      |       |          | BLENDED | ResidVar <sub>blend</sub> | VarContr <sub>blend</sub> |
|--------------|-------|----------|---------|---------------------------|---------------------------|
| ID           | Resid | ResidVar |         |                           |                           |
| AAPL         | 9.330 | 1044.587 | AAPL    | 980.188                   | 215.672                   |
| MSFT         | 4.080 | 199.757  |         |                           |                           |
| NEAR HORIZON |       |          |         |                           |                           |
| ID           | Resid | ResidVar |         |                           |                           |
| AAPL         | 7.760 | 722.593  |         |                           |                           |
| MSFT         | 3.393 | 138.182  |         |                           |                           |
|              |       |          | 259.468 |                           |                           |

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sidual" additional factors as has been the case with our other time series models. A more detailed discussion of the model changes was presented in our last newsletter issue, <http://www.northinfo.com/Documents/544.pdf>.

Certain changes to the risk model line-up will occur later in 2013. The equity portion of the **Everything, Everywhere** model will retain the structure of the current (2nd generation) Global equity model for the next few months, but will eventually switch to the 3rd generation structure. The US REIT and Global REIT models will also have changes later in the year. There will be minor changes to the factor structure of the models, and coverage will be extended somewhat to include a select range of non-REIT real estate operating companies.

### New Features and Functions of the Optimizer and Risk Reporting

For those clients using our Windows-based *Open Optimizer* system, there will be a very powerful new feature in the graphical user-interface (GUI). The structure of the GUI itself is now under the control of users. It is now possible for individual users to revise the screen and page layouts within the Optimizer GUI to customize the entire application to their own particular workflow. Entire configurations of the GUI input and output screens can be saved as a "screen layout." For example, an investment firm might have one version of the GUI for their team of experienced quantitative portfolio managers, and a much simplified layout for junior analysts preparing routine risk reports.

Our investment manager clients have a broad range of styles and approaches. To accommodate differing levels of portfolio turnover, since 2009 Northfield has provided risk models with two distinct forecast horizons. Our standard forecast horizon is one year (today to one year from today), while our "near horizon" models utilize the same basic model but uses additional market information to adjust the forecast to a two week ex-ante horizon. Starting with the systems release at the end of March, users will be able to do **Risk Control Horizon Blending** to customize the risk forecast time horizon to suit their own investment style. All risk model users will be able to blend the regular and "near horizon" models using data from the most recent monthly update. Based on Northfield research the default blend will be 80% weight on the regular model and 20% weight on the near horizon model. Clients who have purchased optional full access to the near horizon data will continue to receive daily updates of the near horizon data and the blending feature will use appropriately recent daily data when available.

The new systems will also provide several new forms of analytical output that we believe are of vital importance to our clients. The first of these addresses the issue of **Con-**

**centration Risk** within multi-asset class portfolios. For example, if a portfolio contained common stock of Bank of America and also contained a bond issued by Merrill Lynch (now a subsidiary of Bank of America) the fact that the two securities are now associated with the same issuer will be appropriately taken into account within the risk and optimization calculations. A second new analytical metric within our system is a unique new measure of **Active Risk** that incorporates both the effect of tracking error and "strategy risk" into a single unified risk value. For more background on the Active Risk measure, please see <http://www.northinfo.com/documents/349.pdf>.

The final new analytical measure to be added to our basic systems is a **Liquidity-Adjusted** version of absolute portfolio volatility. As demonstrated by the extreme market events during the "deleveraging" events of 2007, liquidity should be a major concern for all investors. For more information on how we frame portfolio liquidity policy and formulate our measure, please see <http://www.northinfo.com/documents/545.pdf>. As described in the preceding document, Northfield also now provides free access to a **Liquidity Planning Tool** application that allows traders to estimate the cost of trades in any global equity of any number of shares to be completed over any particular number of trading days. We believe this application is a major step forward in liquidity planning for asset managers.

For clients utilizing Northfield computations through the aforementioned third-party delivery platforms, we expect that the new analytical features to be available within the next few months although there is likely to be some delay as the new functions will require related modifications of the delivery platform software.

### New Features and Functions of our Performance Attribution System

A major new release of our Performance Attribution system will also be made available in the next few weeks. The key difference between the new version and the predecessor is an *extensive new capability to produce presentation quality reports, graphs and charts* using an embedded version of the **Crystal Reports** report generator. The new version takes the very extensive reporting output of our analysis and automatically loads it into commonly used SQL databases including systems like **MySQL** which are available to end users at little or no cost. The Crystal Reports system can then be used to retrieve the data from the database and generate an essentially infinite variety of user defined reports and graphics.

The Performance Attribution system has also had a variety of "behind the scenes" enhancements that allow it to handle analysis of much larger problems as might be common in the context of back-testing for investment re-

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search. For example, capacity is now sufficient to handle a twenty year monthly back-test involving security universes with a thousand or more members. Later in 2013, a new GUI consistent with our desktop Open Optimizer will also be added to this application.

### Logistical Aspects of the Risk Model Change Over

It is our intent to make the changeover to the 3rd generation models as seamless as possible for clients. As of April 1, 2013, the routine data delivery mechanisms direct from Northfield (WebInstall and LiveUpdate) will change over the 3rd generation models. At the same time, our desktop software applications will begin to automatically recognize the new data. We anticipate that all data delivered over third party portals such as FactSet, Thomson Reuters QA, Investedge, and the S&P Capital IQ Clarifi systems will change over at the same time.

For clients who wish to receive data for the current 2nd generation models so they can handle the transition on their own time schedule, we will continue to produce the 2nd generation data for a period of a few months. This data may be obtained from Northfield via FTP delivery and run in our software applications in "Generic" mode. Data for 2nd generation models will also be provided to all third party delivery portals, but clients should check with their provider as to procedures for accessing 2nd generation model data once the 3rd generation models are in use. We ask that clients please contact Northfield tech support to request continuing FTP access to 2nd generation models.

Clients who receive data direct from Northfield should pay close attention to several logistical issues. The first is that naming conventions for some data files have been changed to make the naming processes more consistent from one model to another. In addition, if clients are using extra files that represent non-standard base currencies (e.g. a US model being analyzed assuming a Japanese base currency) the naming conventions for some of those files have changed also. Please contact Northfield tech

support for a complete list of new file naming conventions. The next logistical issue is that there will be a few new files sent with each monthly update. Some of these new files will relate to the new "horizon blending" feature of our risk analysis process. The remaining additional files will contain data needed for the **Liquidity Planning Tool** mentioned above.

A third logistical issue is that the main data file (i.e. security level information) for each delivery of a risk model will contain six additional comma-delimited fields. Two of these extra fields will be used with encrypted content in conjunction with the **Concentration Risk** metric described above. The remaining additional fields are reserved to carry data for planned enhancements to our risk analyses.

The final issue of concern for clients who receive their data direct from Northfield relates to the matter of risk model data history. We strongly recommend that clients who have purchased or maintained an ongoing history of their Northfield data to move the historical data to a separate computer file folder in order to avoid a confusion of historical files from the 2nd generation and 3rd generation models. Clients who have purchased 2nd generation data history may request 3rd generation model history at no charge. Clients who have not purchased access to the full history of the 2nd generation models may request a free three month sample of 3rd generation history for transition purposes, or purchase access to full 3rd generation history. We expect that all third party delivery platforms will be updating their stored history of Northfield models to the 3rd generation history in the near future.

### Further Questions

Documentation on the model revisions (including empirical test results) and new system features will be distributed in March. If any client has any additional questions or concerns, please contact your regional Northfield office, our central technical support line (617.208.2080, [support@northinfo.com](mailto:support@northinfo.com)) or the technical support staff of your third party delivery provider.

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For a complete index of all former Northfield News articles, visit <http://www.northinfo.com/documents/314.pdf>

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