February 2005

Northfield News

Quarterly Newsletter for the Friends and Clients of Northfield Information Services

Using CUSUM Methods for Monitoring External Asset Managers

By Dan diBartolomeo and Sandy Warrick

Northfield's Allocation Research Toolkit, ("ART") provides a new way to monitor the quality of investment process at an external asset manager using a statistical process control technique called "CUSUM" or ***Cu****mulative* ***Sum.*** CUSUM is a mathematical technique that has been used for a long time in industrial management to detect whether the quality of a process is normal, improving or deteriorating. CUSUM is one of many techniques that fall into the "backward looking" form of a "Sequential Probability Ratio Test" as pioneered by Wald, (1947). The CUSUM method was first proposed by Page, (1954) as a way to rapidly detect changes in the quality of a process. For example, CUSUM statistics are used to monitor the number of defective goods produced by factories in order to determine if the machinery on an assembly line needs repair or replacement.

When we study any set of data, the first statistic we look at is the average. Unfortunately, it is difficult looking at the average to detect small but possibly significant trends in the data that may signal a change in the underlying process. In calculating CUSUM, we pay attention to the cumulative sum of the data values. When plotted as a line graph, the slope of the CUSUM line is equal to the average of the data values. This is of critical importance. It is much easier visually to notice differences in the slopes of lines than it is to notice small changes in their level. As such, we are able to take notice of trends in the data more easily.

If an investment fund is actively managed, we can think of the manager's process like any other work process. Obviously, we would intend to hire active managers we think are good, and would like to monitor the activities to assure ourselves that nothing has gone wrong with the investment process.

At Northfield's 2003 conference in Stowe Vermont, Tom Philips presented a paper on how CUSUM was used by the IBM pension fund to monitor their external active managers.[1] This paper has subsequently been published in a journal. According to Tom, hundreds of billions of dollars in actively managed funds are monitored using variations on the CUSUM method.

The method of Philips, Yaschin and Stein ("PYS") is to compute the annualized information ratio for each return of each period of a funds return. The information ratio is just the excess return divided by the standard deviation of excess return (tracking error). The information ratio is a widely used way to measure the risk/reward tradeoff of the active management process. Assuming monthly data:

(Continued on page 4)

Inside this Issue

Special points of Interest:

- March User Seminar
- Asia Research Seminars Wrap-up
- New London Office Staff Member
- New "Live Update" feature
- Northfield Annual Conference Announcement

Recent and Upcoming Events

Northfield User Seminar

Northfield's Boston Office • 184 High Street, Boston, MA • March 8th and March 10th, 2005

This first of its kind seminar at Northfield, is part of a new effort developed to provide our current clients and prospects with training and a practice based review of common issues associated with everyday usage of Northfield analytical tools. In addition, advanced areas of contemporary interest in the market today will also be presented.

The early morning will feature separate training sessions on Northfield's core offerings: Optimization, Performance Attribution and Asset Allocation. Ample time during these sessions will be allotted to answering your questions and exploring ad-hoc situations as they may arise. The late morning and afternoon will feature the advanced presentations.

At the conclusion of our workday, we invite our guests to join us for a cocktail reception during a 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, and features world champion Robert Fahey of Australia and Tim Chisholm of Boston, the number two worldranked player. The evening activities on March 8th will also feature a live musical performance by singer/songwriter Sam Martin.

If you would like to attend, Please RSVP to Kathy Prasad by fax (617-451-2122) or email, kathy@northinfo.com.

Please note: The March 10th Seminar is full, space is available for the March 8th Seminar

A registration form and an agenda with more detailed track and presentation descriptions is available on the Northfield website, http://www.northinfo.com/events/useragenda.pdf.

Agenda:

8:30 AM Continental Breakfast

9:00 AM Welcome

9:15 AM There will be four track options for attendees

Track I - New users' guide to the Northfield Open Optimizer and Risk Management System.
Track II - New users' guide to the Northfield Allocation Research Toolkit.
Track III – New users' guide to the Northfield Open Performance Attribution system.
Track IV – Non-Users' Primer for all 3 Northfield Products: Open Optimizer & Risk Management System, Open Performance Attribution, and Allocation Research Toolkit.

11:15 AM *Break*

Afternoon Sessions: Advanced Presentations on Areas of Contemporary Interest:

11:30 AM *Proxy Holdings for a Hedge Fund*

12:15 PM *Box Lunch*

1:15 PM *Rational Long/Short Portfolios*

1:45 PM *A Simultaneous Solution for Optimization of Multiple Related Accounts*

2:45 PM *Extracting Useful Information from a Back-Test*

3:45 PM *Brief Concluding Remarks*

4:30 PM *Cocktail Reception*

Open Court Tennis Championships Men's Single Semi-Final

Hamlen Room, Tennis and Racquet Club of Boston, 939 Boylston Street, Boston 02115, 617.536.4630

2005 Newport Annual Summer Seminar

Tennis Hall of Fame • Newport, Rhode Island • June 10, 2005

We are pleased to invite you and your colleagues to our annual summer seminar. The purpose of the seminar is to present recent research and technical advances to our clients and friends. This year we return to the International Tennis Hall of Fame. Our meeting date has been selected to coincide with the US Professional Championships of Court Tennis. After tennis on Friday evening, Northfield will host a dinner party for the seminar attendees and their guests.

There is no charge for participation in any aspect of this event. Please RSVP to Kathy Prasad at 617.208.2020, or e-mail, kathy@northinfo.com. The full seminar agenda will be posted to www.northinfo.com as it becomes available.

2005 Northfield Annual Research Conference

The Fairmont Le Chateau Montebello • Montebello, Quebec, Canada • July 18-20, 2005

We are pleased to announce our 18th annual research conference at the Fairmont Le Chateau Montebello, in Montebello, Quebec, Canada. The conference will officially begin on Monday, July 18th and end on Wednesday, July 20th.

Le Chateau Montebello

As is customary at Northfield events, a complete recreational and social calendar will accompany the working sessions. The Fairmont offers a number of vacation activities to choose from including golf, horseback riding, hiking, fishing, canoeing, wildlife watching and skiing.

Further details and the complete conference agenda will be posted on the Northfield Website at www.northinfo.com as they become available. Contact Kathy Prasad at 617.208.2020, kathy@northinfo.com for more information.

New Frontier Advisors Annual Research Conference

The Hyatt Regency Hotel • Cambridge MA • May 11-13, 2005

Northfield's strategic partner New Frontier Advisors (NFA) is pleased to announce that their second annual research conference will take place May 11-13 at the Hyatt Regency in Cambridge, MA. This year's conference is entitled "The Resampling Revolution in Investment Management." The conference presentations have been extended this year from one to two days and will consist of a day and a half of research followed by a half day of case studies and hands on presentations of NFA's asset allocation and equity portfolio optimization technology. Also new this year is a one hour introductory-level pre-conference tutorial session on resampling and other essential statistical methods that are part of the presentations.

A reception and buffet dinner is scheduled for the evening of May 11th, a dinner banquet on May 12th and a reception on May 13th. Please contact Allison Bell at 617.482.1433 ext. 109 or abell@newfrontieradvisors.com for more information.

Asia Seminars Wrap-up

December 2004 • Tokyo, Hong Kong and Sydney

In December, we hosted our first ever Asia Seminar Series, beginning 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 and Northfield's Asia Marketing Director Nick Wade. Topics included: Credit Risk Modeling Using Market Implied Measures, CUSUM Analysis for Manager Evaluation & Monitoring, Equity Risk Modeling: Innovations in Methods & Best Practices, Growth/Value/Momentum, Investment Decisions: An Epistemological Perspective, Realistic Inclusion of the Market Impact of Large Trades, Subtleties for Long/Short Investing, The Dual Benchmark Problem, and The New Paradigm for Taxable Portfolio Management.

We plan to host a similar series of events on an annual or more frequent basis with the same Northfield signature format; a relaxed and informal series of topical and detailed presentations encouraging lively discussion in a relaxing venue accompanied by excellent food and wine. To request seminar proceedings, send an e-mail to staff@northinfo.com.

(Continued from page 1)

$$\text{Excess Return}_t = \text{Fund return}_t - \text{Benchmark index return}_t$$

$$IR_t = \frac{12 \times \text{Excess return}_t}{\text{Standard deviation of excess return}_{t-1} \times 12^{1/2})}$$

If the IR value is positive, the manager is beating the benchmark. If the IR is negative, the manager is underperforming the benchmark. Consistency in the excess returns would decrease the standard deviation, increasing the magnitude of the IR value. Once the IR for each period has been calculated, the value of CUSUM (just add up the IR values in a series) is calculated across time.

$$CUSUM_t = \sum_{t=1}^{T} IR_t$$

The PYS method assumes there are three possible states for our beliefs about active managers:

1. They are a good manager
2. They are a bad manager
3. We don't know

In PYS, the slope of the CUSUM line represents the average value of IR. A rising CUSUM line indicates that the manager is beating the benchmark index, while a falling CUSUM line indicates underperformance. In an example in the PYS paper, they assume that a good manager has IR (slope) > 0.5, while a bad manager has IR < 0. Values between 0 and 0.5 represent the "don't know" case.

However, in measuring the slope of the CUSUM line we must make the critical decision as to which portion of the line is relevant. This is where the "backward looking" part comes in. After each time step, we calculate the slope of a line drawn from the current value of the CUSUM line to every prior point in the CUSUM line. We can then ask ourselves two questions for each data point:

a. What is the probability that the slope of line from time point (T-X) to the current point (T) would arise by accident if the true value of the manager's IR was greater than 0.5? If this is low, this tells us the manager was probably a good manager for this time interval.

b. What is the probability that the slope of line from point X to the current point would arise by accident if the true value of the manager's IR was less than zero? If this is low, this tells us the manager was probably a bad manager for this time interval.

$$L = \text{Log}\left(\frac{\text{Probability that the true IR <=0}}{\text{Probability that the true IR is > 0.5)}}\right)$$

Now we have L for the time period from the first data point until now, L for the time period from the second data point until now, and so on. We select the time interval (from then until now) where the value of L is highest. This is the period over which our manager has the highest probability of being a bad manager.

The final step in PYS is to determine if L is large enough and has covered a long enough time period that we consider it a significant change in the quality of the manager's process as opposed to some temporary bad luck. In the ART software, we call this threshold value, the Decision Interval. What value is best for the decision interval depends on the assumptions you want to make about the process, and the extent you are concerned about detecting small changes in process quality, and the concerns about "false alarms." High values for the Decision Interval will be slower to alert investor's to declines in process quality, while too low values for the Decision Interval will create many false alarms. Unfortunately, the estimation of the ideal value of the Decision Interval for each particular case is very complex.

Our implementation of CUSUM methods is different than in the method of Philips Yaschin and Stein. In PYS, the key issue is whether a manager fits into a category of "good", "bad" or "don't know". The CUSUM process that has been built into ART is similar to PYS, but our process operates directly on the issue of whether a manager's process is improving or deteriorating. These are not equivalent concepts.

Imagine a manager that was consistently outperforming the benchmark index by 50 basis points each month for a while, and then starts to consistently outperform by 25 basis points for the subsequent period. In the PYS method, this manager would be "good" throughout the entire sample, as the IR is likely to have remained well above 0.5. In our process, we would say that the manager's process quality is declining. The manager is still good, but not as good as before. Similarly, a "bad" manager can still be bad while improving. In our method, the key unit of measurement is the standardized active return from time period. This measure is similar, but not identical to the IR used in the PYS method.

In ART, the benchmark index can either be specified as a recognized index from the ART database, or as the combination of indices found to be most appropriate by a returns-based style analysis.

(Continued on page 5)

$$\text{Excess Return}_t = \text{Fund return}_t - \text{Benchmark index return}_t$$

$$IR_t = \frac{12 \times \text{Excess return}_t}{\text{Standard deviation of excess return}_{t-1} \times 12^{1/2})}$$

$$SAR_t = \frac{12 \times \text{Excess return}_t - \text{Mean Excess return}_{t-1}}{\text{Standard deviation of excess return}_{t-1} \times 12^{1/2})}$$

$$CUSUM_t = \sum_{t=1}^{T} SAR_t$$

By subtracting off the mean of past excess returns, we cause SAR to have a distribution that is unit normal (mean = 0, standard deviation = 1). This means that when we take the cumulative sum of SAR values over time, the expected value of the CUSUM is zero for all managers (good, bad and don't know). In our process, an upward sloping CUSUM line indicates an improving manager, while a declining CUSUM line indicates deterioration in the active management process, which is done because changes in slopes are easier to see than changes in levels.

ART's method has one other advantage over PYS. While IR is a widely used measure of active manager quality, it has some serious limitations. Consider the case of a manager who has a 0.02% annual excess return with a tracking error of 0.01%. While an IR of 2.0 is very, very good, adding only one fiftieth of one percent to an investor's return is economically meaningless. By concentrating on SAR, we are looking directly at changes in active management process quality, irrespective of the aggressiveness level at which active management is undertaken.

In order to compute the value of SAR_t, we need to get initial values for the mean and standard deviation of the excess return. We do this by keeping a "holdout sample" consisting of the first data points of the return time series. The sample statistics from the hold out sample are used to compute SAR for the first data point to be included in the CUSUM. ART users can vary the holdout sample length (*HSL dialog box in ART*). Currently, the default value of HSL is set to 12, but 24 may be more appropriate. If HSL is too low, the initial sample may not be indicative of the true process, and the active management process will appear to be very noisy and unstable. On the other hand, if HSL is too long, the amount of data available to be analyzed by the CUSUM process will be reduced.

Once we have computed the CUSUM of SAR, we must identify the data point in the time series of SAR values that represents the critical value as is done in the PYS method. In that SAR is unit normal, its distribution has a standard deviation and variance are equal to one. The variance of a sum is equal to the sum of the individual variances. If we assume that there is no serial correlation in the changes of manager process quality, the expected value of the sum of two data points in a CUSUM is zero, with a variance of 2 and a standard deviation of the square root of 2. For a series of ten points, the expected value of the sum is still zero, the expected variance is 10, and expected standard deviation is the square root of 10.

Given the above relation, we have a simple way to find the critical time point. We simply subtract the value of CUSUM(x) at each past point in time from the CUSUM value at the end of the time series, CUSUM(t). This difference is then scaled by the square root of the number of data points in the time interval to calculate Z(x). The highest value of Z(x) represents the critical point in the CUSUM series.

There are a number of ways to interpret CUSUM output:

1. Another benefit of having SAR be unit normal is that the same value of the Decision Interval should be applicable over a wide range of funds. The Decision Interval is represented in an ART chart by a horizontal line at a value of +/- the Decision Interval. If the CUSUM line crosses the Decision Interval line, this can be interpreted as meaning that the degree of change in the manager's process quality warrants examination.
2. If monitoring an existing manager, wait for the CUSUM line to cross a Decision Interval Line (now is time T). ART will then find the critical point (X) and compute descriptive statistics about the excess returns of the fund during the time interval from X to T. The ART user can then review these statistics and the slope of the CUSUM line between X and T to determine whether their opinion of manager performance agrees with changes in process quality. This is the traditional CUSUM approach of waiting for an alarm and reacting to it.
3. If the user is considering several managers (e.g. hiring), it is unlikely that these managers will coincidentally have their CUSUM lines crossing the Decision Interval line in a concurrent fashion. In this case, we can just assume that the most recent data point is time T, and proceed as above.
4. If the crossing point is in the far past (see graph on next page), we may assume that the critical point (X) and the crossing point were close in time, we can then examine the manager's record and the CUSUM line from the crossing point to the most recent data point.
5. If there are frequent crossings of the Decision Interval line, the manager's process quality is highly unstable (noisy) or the size of the holdout sample is too small.

(Continued on page 6)

In ART, we have also introduced the concept of an Upper CUSUM and a Lower CUSUM. This is a mechanism to filter small values of SAR(x) that are presumed to be just random noise out of the data. In ART, the *Reference Value* (K) controls the application of the filtering.

$UPCUSUM_t = MAX[0, SAR_t - K + UPCUSUM_{t-1}]$

$LOWCUSUM_t = MAX[0, -K-SAR_t + LOWCUSUM_{t-1}]$

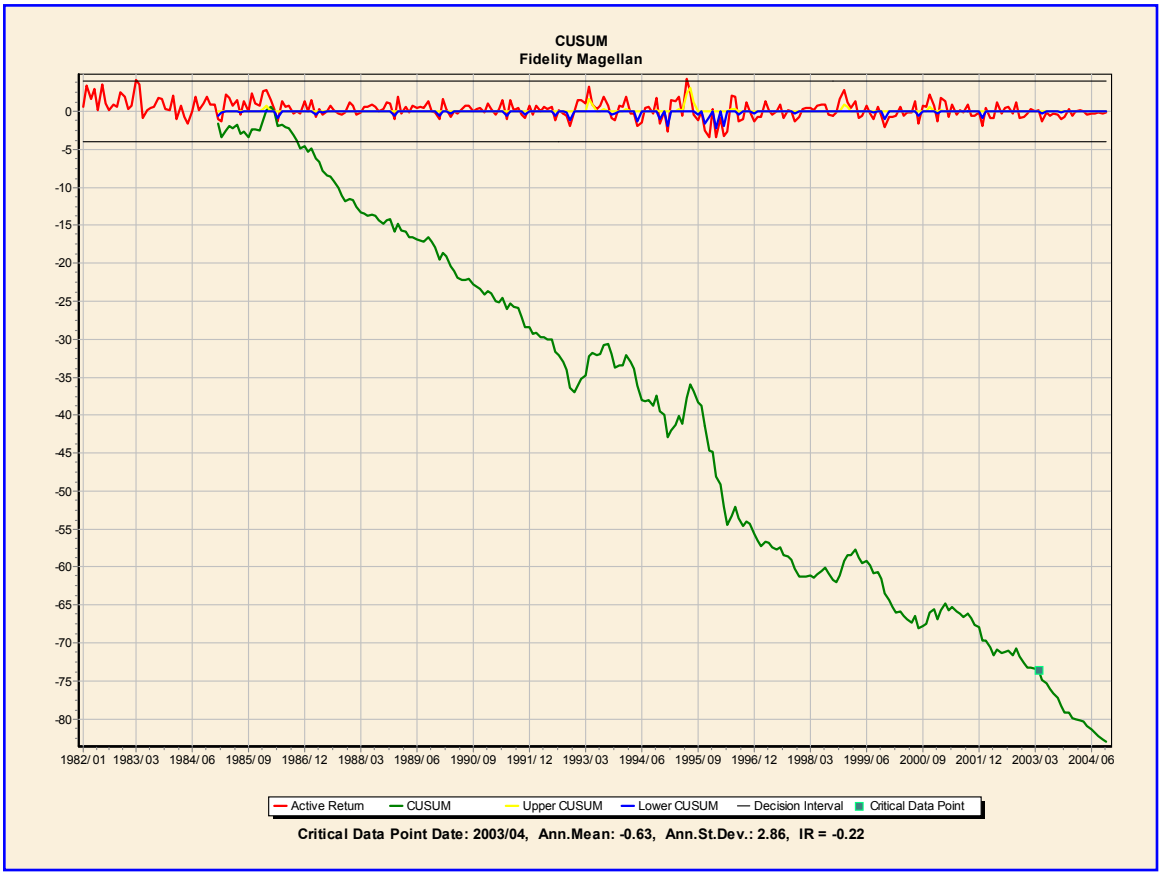
Note that both the Upper and Lower CUSUM are the maximum between zero and a calculated value.

Interpretation of the Upper and Lower CUSUM lines is as much in (2) above. If the Upper or Lower CUSUM lines cross the Decision Interval lines, the change in the manager's process quality is presumed be worthy of examination. Higher values of K will decrease the sensitivity of the CUSUM line to small changes in SAR. We will detect changes in quality more slowly, but with fewer false alarms. Again, the finding of the ideal combination of the Decision Interval and the Reference Value is very mathematically complex. It is common in industrial process engineering to set K at a value of about half the smallest change in process quality that is of concern. The default value in ART for the Reference Value is currently set to one.

To demonstrate, we show a sample case for the Fidelity Magellan fund. (see below) (Decision Interval = 4, Reference Value = 1, Holdout Sample Length = 36). We used a combination of the 4 default indices (Russell 1000 Growth, Russell 1000 Value, Russell 2000 Growth and Russell 2000 value) to construct the benchmark index via returns-based style analysis. The entire period for which data is available is January 1982 through October 2004. If we look at the red line on the graph (monthly excess returns) we see that it seems to bounce around zero rather randomly. For the entire period, the excess return of Magellan over the benchmark index was 2.66% per year with a tracking error of 4.48% (IR = .59). However, when we look at the CUSUM line, we see that it crosses the lower Decision Interval line around the beginning of 1987 and goes pretty much straight down from there. The critical point is around the middle of 1986.

Let's now break our entire time sample into two parts 1982 through 1986, and 1987 to the present day. From 1982 through 1986, the excess return of Magellan over the benchmark was 11.01% per annum with a tracking error of 4.46 (IR = 2.46). From January 1987 through October 2004, the excess return is just 0.65% with a tracking error of 3.98% (IR = 0.16).

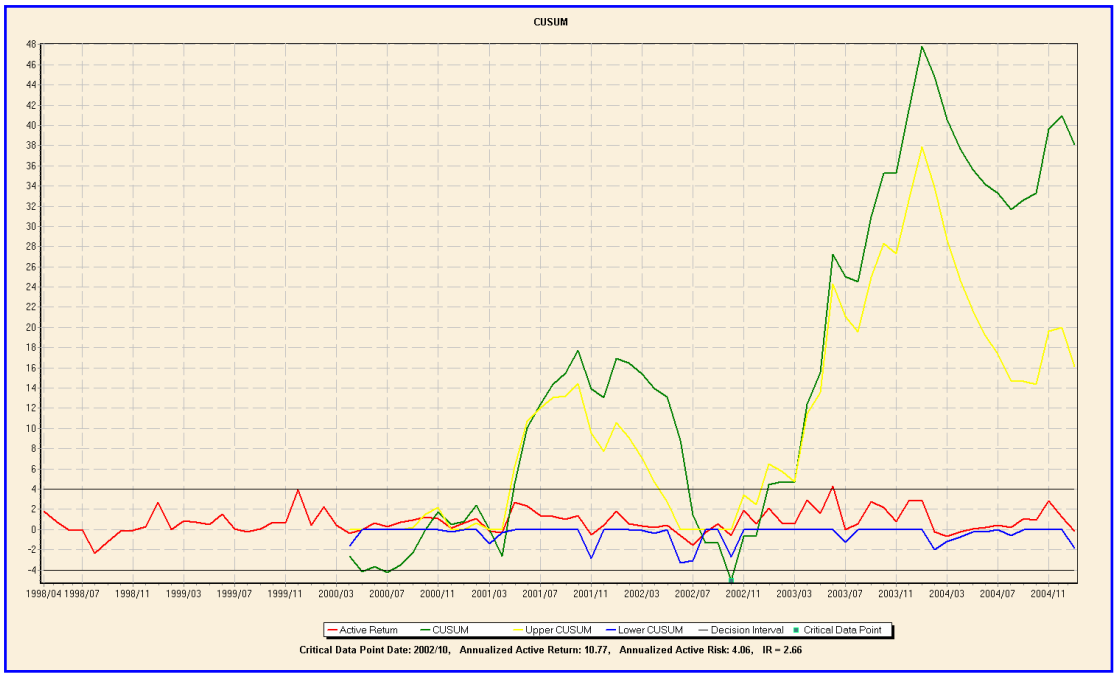
While the annualized excess return of Magellan is positive for both sub-periods, the effectiveness of active management seems to have dropped dramatically sometime around the end of 1986 and appears to continue to decline.



(Continued on page 7)

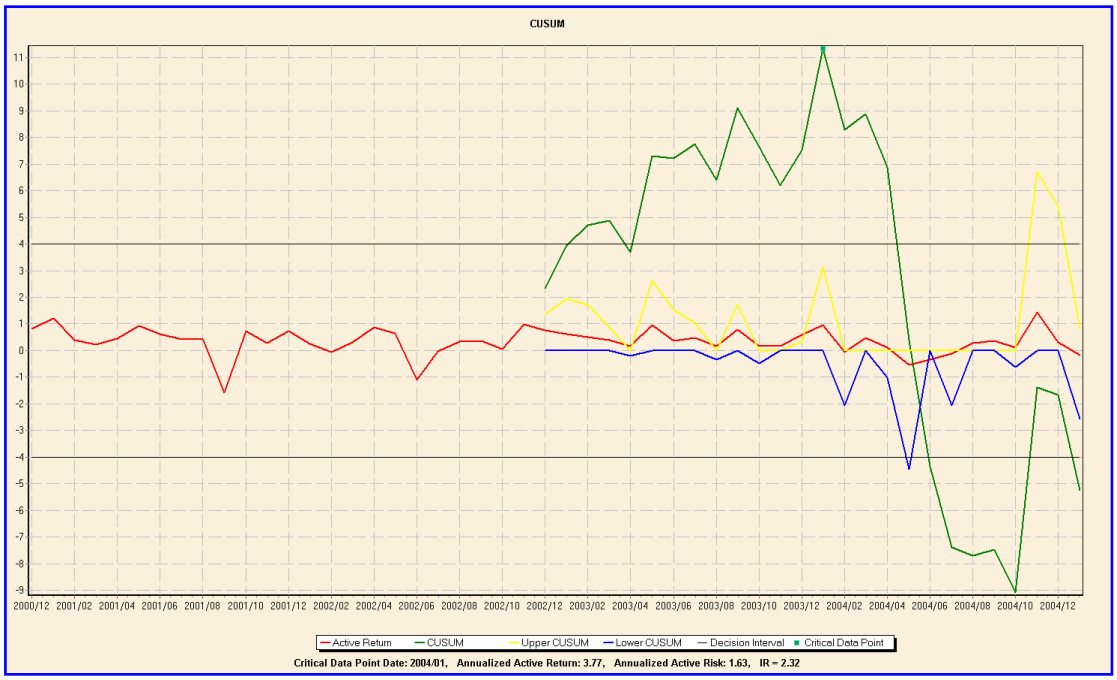
As a second example, we compare two top quartile (return to risk) distressed securities hedge funds. It is "accepted wisdom" in the hedge fund community that funds generally start out hot and, for various reasons, performance deteriorates over time. This is an ideal application for CUSUM, since it can determine if a manager's performance is trending downward after the critical point.

For the first fund, the critical point occurred in October 2002, after which the fund's performance vs. a cash benchmark has been an average annual return of 10.77% at a tracking error of 4.06, an information (and Sharpe, since the benchmark is cash) ratio of 2.66. In other words, this is a fund whose recent performance is very good and has been improving over the last two years



Although the second fund has a similar Sharpe ratio over the last five years, the story is somewhat different. The fund has been good throughout 2004, with an active return of 3.77% at a risk of 1.63, the performance started a downtrend at this period, and the fund's edge may be deteriorating.

We believe CUSUM is an excellent due diligence technique by producing a "signal" to those whose task it is to monitor external manager process and performance. The signal is best viewed as a point in time that suggests further questioning of the manager being analyzed. *(continued on page 8)*



Cusum Article References

[1] Philips, Thomas, Emmanuel Yashchin, and David Stein, "Using Statistical Process Control to Monitor Active Managers," *Northfield Conference Proceedings 2003*. Forthcoming *Journal of Portfolio Management*. http://www.research.ibm.com/stat/ qprc/papers/Phil2003qprc.ppt

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New London Office Sales Manager

Northfield's London office is expanding again as a result of the significant growth in Northfield's European client base.

We are very pleased to announce that David Murdoch will be joining Rupert Goodwin and Christine Milne in Northfield's London office .

David joins from Starmine where he was regional sales manager for northern Europe. Previously David managed part of both the Datastream and I/B/E/S products at Thomson where he had also successfully sold I/B/E/S services. He has over 12 years experience in international sales and the product management of quantitative research applications, data, research and real time analytical and decision support tools.

David can be reached at +44-(0)20-7801-6230, David@northinfo-europe.com.

Northfield Staff Speaking Engagements

Northfield President Dan diBartolomeo will be speaking at the FRA Investment Performance Measurement and Attribution Analysis Symposium at Amelia Island, Florida on March 15th. The topic is whether daily or monthly performance attribution is actually more useful. Visit http://www.frallc.com/performance.asp#b264 for more information.

On March 29, Dan will be moderating a panel at the FRA Portable Alpha conference at the Harvard Club in New York City. Visit http://www.frallc.com/alternative.asp#b263 for more information.

Northfield at the MMI Conference

Northfield will be exhibiting at the Money Management Institute 2005 Annual Conference, March 29-30, in Philadelphia. Visit http://www.moneyinstitute.com for more information.

Live Update at Northfield

Over the next few months a "Live Update" system will be introduced for Northfield products. We expect Live Update to increase greatly the convenience of using Northfield's applications and data. The Live Update client is a stand alone windows application which will be installed as part of the NIS investment suite from CD or webinstall. It communicates with the NIS server for downloading updated software or data. You can launch 'Live Update' manually or it will check for new updates automatically on a frequent basis (automatic update will be available shortly).

During this communication, it will be determined if software upgrades or new sets of data are available for the particular user's installation. If so, the new software or data will be automatically downloaded and installed. This will substantially reduce the need for users to use our monthly "webinstall" process to keep their system up to date.

The capabilities of the Live Update system will be expanded gradually. Another application will be the distribution of historical data sets in an "on demand" fashion, rather than in bulk on CDs as it done today. Eventually, we hope to extend the communication process to transmit current data records on individual securities for our systems in order to keep up with corporate actions such as stock splits, identifier changes and mergers on a daily basis.

We also hope to use Live Update to allow locally installed data files to be augmented from the Northfield central server. At the moment, the dataset for our Everything Everywhere model contains over three-hundred thousand securities. We expect this number to grow to over four million as coverage expands to include financial instruments such as mortgage-backed securities and US municipal bonds. Rather than trying to manage such a huge data file at each user site, we will constrain the EE data file sent to clients to a couple hundred thousand of the most popular securities. If a client inputs a portfolio that contains a security identifier that is not contained in the local data file, the Live Update process will be able to immediately query the Northfield central server for a data record on that security, and add this one data record to the local file. Only if a user input identifier is found neither locally, nor on the Northfield central server would an "exception" be generated.

If you have any suggestions of what you would like to see covered in upcoming issues, please e-mail your ideas to staff@northinfo.com

Technical Support Tip: Open Performance Attribution
How to Run a Quarterly Attribution
By Howard Hoffman

There are three things you need to change from a monthly problem in order to run a quarterly performance attribution.

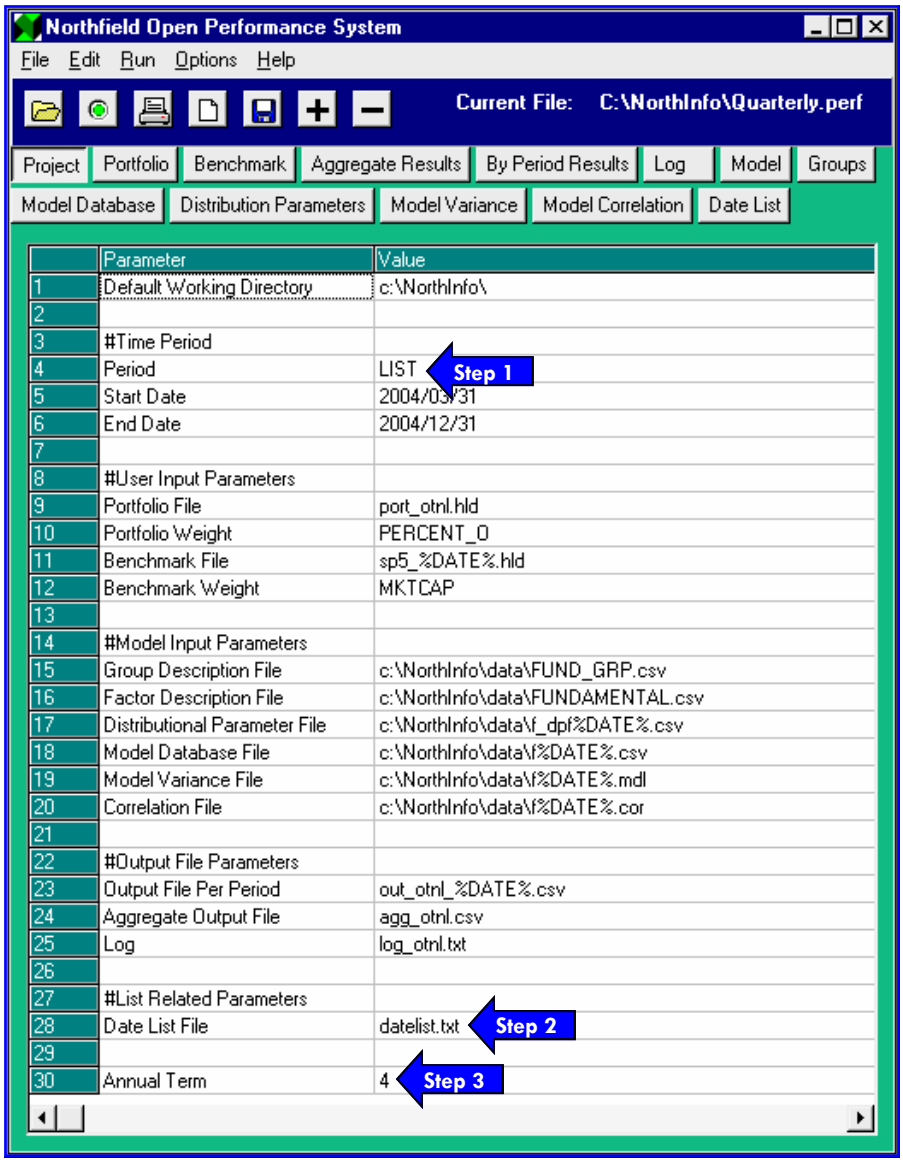
1. Change the Period from "Monthly" to "List"

2. You must create a date list and point "Date List File" to this file. A date list is a text file with the dates that define a period in YYYY/MM/DD format. It is important to include the date of the period before your start date. For example, to run a quarterly attribution for 2004, the date list would look like this:

   2003/12/31
   2004/03/31
   2004/06/30
   2004/09/30
   2004/12/31

   The start date would be 2004/03/31 and the end date would be 2004/12/31.

3 Set the Annual Term to "4"



The Northfield Technical Support staff is always available to answer any questions. Please send your e-mails to support@northinfo.com or call 617.208.2080. European clients can contact our London office by e-mailing christine@northinfo-europe.com or call +44 (0)20.7801.6260. For Asian and Australian clients, contact Nick Wade, nick@northinfo.com, +81.3.5403.4655.

Boston Office
184 High Street, 5th Floor
Boston, MA 02110

Phone: 617.451.2222
Fax: 617.451.2122
Sales: 617.208.2050
Tech Support: 617.208.2080

London Office
Shakespeare House
168 Lavender Hill
London, SW11 5TF

Phone: +44-(0)-20-7801-6260
Fax: +44-(0)-20-7801-6261

Tokyo Office
Shiroyama JT Trust Tower
4-3-1 Toranomon
Minato-ku
Tokyo 105-6016

Phone: +81 (0)3 5403 4655
Fax: +81 (0)3 5403 4646

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