BLUE TRACTOR

December 5, 2017

Brent J. Fields
Secretary
U.S. Securities and Exchange Commission
100 F Street, NE
Washington DC 20549-1090

RE: Notice of an Order Instituting Proceedings to Determine Whether to Approve or Disapprove a Proposed Rule Change to Permit the Listing and Trading of Managed Portfolio Shares; and to List and Trade Shares of the Following Under Proposed Rule 14.11(k): ClearBridge Appreciation ETF; ClearBridge Large Cap ETF; ClearBridge MidCap Growth ETF; ClearBridge Select ETF; and ClearBridge All Cap Value ETF [Release No. 34-81599; File No. SR-BatsBZX-2017-30]

Dear Mr. Fields,

On behalf of Blue Tractor Group, LLC ("Blue Tractor"), I am pleased to provide the U.S. Securities and Exchange Commission (the "Commission") with commentary concerning the Commission's September 13, 2017 notice (the "Notice") designating a longer period whether to approve or disapprove the rule change application submitted on June 1, 2017 by Bats BZX Exchange, Inc. (the "Exchange").[1, 2, 3, 4]

Fundamental to my comments is the intellectual property developed by Precidian Investments LLC ("Precidian") that underpin the five non-transparent exchange traded funds sub-advised by ClearBridge Investments, LLC ("ClearBridge") that the Exchange proposes to list and trade and that are described in a Form N-1A preliminary Registration Statement filed on April 4, 2017 by Precidian ETF Trust.[5, 6]

This letter also references selected public comment letters published on the Commission's website in relation to NYSE Arca, Inc.'s April 14, 2017 rule change application to list and trade ETF shares sub-advised by Royce & Associated, LP ("Royce") because the non-transparent ETF funds issued by Royce and ClearBridge will operate using identical intellectual property developed by Precidian.[7]

Most importantly, this letter makes particular note of the memorandum published by the Commission's Division of Economic Risk and Analysis on November 16, 2017 entitled *"Inferring Non-Transparent ETF Portfolio Holdings"* ("DERA" and the "DERA Memorandum") on the Commission's website in relation to

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[1] See https://www.sec.gov/rules/sro/batsbzx/2017/34-81599.pdf (Release No. 34-81247; File No. SR-BatsBZX-2017-30)
[2] See https://www.sec.gov/rules/sro/batsbzx/2017/34-80911.pdf (Release No.34-80911; File No. SR-BatsBZX-2017-30)
[3] As background, I am the founder of Blue Tractor Group, LLC which on July 31, 2017 filed a third amended application for exemptive relief with the Commission for the Shielded Alpha℠ ETF structure. I am a graduate of the University of London (mathematics) in England and have worked and consulted for over 30 years in both England and United States for many financial institutions, primarily developing and constructing quantitative models related to alpha generation and risk management. I am the sole inventor of the methods and ideas underpinning the Shielded Alpha℠ ETF structure, which is completely different concept to a non-transparent exchange traded fund.
See https://www.sec.gov/Archives/edgar/data/1668791/000168035917000403/bluetractor40app7312017.htm (File No. 812-14625)
[4] Now Cboe BZX Exchange, Inc.
[5] https://www.clearbridge.com/
[6] See https://www.sec.gov/Archives/edgar/data/1701878/000114420417018966/v463050_n1a.htm (File No. 811-23246)
[7] https://www.sec.gov/comments/sr-nysearca-2017-36/nysearca201736.htm (see comment and rebuttal letters, including the letters from Terence Norman and Simon Goulet from Blue Tractor Group, LLC)

the NYSE Arca, Inc.'s rule change application. [8] The DERA Memorandum validates that the Precidian ETF structure can be reverse engineered by a variety of statistical and optimization techniques.

This comment letter complements the letter I submitted to the Commission on August 1, 2017 concerning the Exchange's rule change application. [9] Please note that my updated comment letter contains an enhanced statistical report dated November 26, 2017 from Dr. Anthony Hayter from the University of Denver on reverse engineering the Precidian ETF structure and his detailed comments on the DERA Memorandum – see attached Exhibit One.

It is a fact that reverse engineering a non-transparent portfolio is an exercise in statistics and data analysis. Whether it is or is not possible to reverse engineer the Precidian ETF structure is a quantitative issue that cannot be sugar coated by the qualitative protests by Messrs. McCabe and Criscitello found in Precidian's letters to the Commission concerning the NYSE Arca, Inc. rule change application - mathematics is the only arbiter to prove or disprove the issue. [10]

If Precidian still firmly believes it is 'highly unlikely' that their structure can be reverse engineered then they must present detailed mathematical evidence to counter the specific examples raised by Blue Tractor and DERA and they should not be allowed to generalize simply by referencing the discredited studies prepared by their academic consultants, Drs. Cooper and Glosten.

No doubt Precidian has again privately approached the Commission in an attempt to assuage concerns about reverse engineering and resulting predatory front running. While Precidian has demonstrated little interest in public discourse, I would respectfully suggest that any new statistical evidence they present be released by the Commission into the public domain so that it can be peer reviewed to confirm or refute any claims contained within.

Peer review by Blue Tractor and DERA of the studies prepared by Drs. Cooper and Glosten provided a vital counter balance to the now wholly discredited claim and belief of Precidian that their ETF structure cannot be reverse engineered.

So, to summarize:

1. Precidian continues to rely on the analyses prepared by Drs. Cooper and Glosten that are now discredited;

2. To date Precidian is unable to present mathematical evidence that refutes the concerns raised in my previous letter (and accompanying report by Dr. Hayter);

3. Precidian in their letters say that the concerns raised by Blue Tractor emanate from a 'financial conflict of interest' and 'an attempt to stifle innovation' rather than recognize that the mathematics they have relied on are fundamentally flawed;

4. Since Precidian's core argument on reverse engineering has been shown to be false, then what confidence can the Commission have in the veracity of other major claims they have made,

[8] https://www.sec.gov/comments/sr-nysearca-2017-36/nysearca201736.htm#studies (see SEC Staff Studies and Reports)
[9] See https://www.sec.gov/comments/sr-batsbzx-2017-30/batsbzx201730.htm (see letter from Terence W. Norman)
[10] See https://www.sec.gov/comments/sr-nysearca-2017-36/nysearca201736.htm (see letters from Messrs. Criscitello and McCabe)

including predatory front running, efficient markets, arbitrage, hedging and the like (see public comment letter listing these issues from Gary Gastineau and the letters submitted by my colleague Simon Goulet regarding the NYSE Arca, Inc. rule change application [11, 12]); and

5. Furthermore, DERA has now provided independent confirmatory analysis that the Precidian ETF structure can be reverse engineered (see "DERA Memorandum" section).

DERA Memorandum

The November 16, 2017 DERA Memorandum fully supports the concerns I document in my August 1, 2017 letter that Precidian's 'stylised methodology' for the verified intra-day indicative value ("VIIV") is highly vulnerable to reverse engineering (including the confirmatory analysis prepared by Dr. Anthony Hayter).

DERA's most telling observations were on pages 3 through 6 where they:

1. Question Dr. Cooper and Dr. Glosten's formulation of the reverse engineering problem;

2. Question the statistical methods employed by Dr. Cooper and Dr. Glosten; and

3. Question Dr. Cooper and Dr. Glosten's conclusions.

In stark contrast the DERA Memorandum states on page 6 that, "*Hayter estimates the correct regression specification in levels…*" and then concludes with the statement, *"…the two-pass aspect of his regression approach is an example of an alternative estimation technique that potentially improves upon the standard OLS and LASSO estimations…"*

The DERA Memorandum then presents a clever approach that poses an ordinary least squares problem as a quadratic program ("QP-OLS").

The bottom line is that in contrast to Drs. Cooper and Glosten, both DERA and Dr. Hayter have demonstrated how to correctly formulate the problem of reverse engineering the Precidian ETF structure and then present methods to do so.

Additional key observations in the DERA Memorandum include:

1. By limiting the number of stocks in a fund and the fund's investable universe, reverse engineering is made easier;

2. The success of reverse engineering is dependent upon **both** correct formulation of the regression problem and the method used;

3. The success of an attempt to reverse engineer is dependent upon the number of observations available:
    a. For a small stock universe, a single day's observations may be sufficient;
    b. For a larger stock universe, multi-day observation may be required; and

[11] https://www.sec.gov/comments/sr-batsbzx-2017-30/batsbzx201730.htm (see letter from Gary Gastineau)
[12] https://www.sec.gov/comments/sr-nysearca-2017-36/nysearca201736.htm (See letters from Simon Goulet)

   c. As the expected number of fund holdings increase in both small and larger stock universes, while the problem of reverse engineering becomes more complex it does not become intractable;

4. Affirmation that just because one party is unable to undertake reverse engineering it **does not follow** that another party will be unable to do so; and

5. That initial successful iterations in a reverse engineering problem should be considered the lower bound of what is achievable. Indeed, DERA states on page 6 of their memorandum that, *"Any success in reverse-engineering the portfolio weights should therefore be considered **a lower bound** [emphasis added] on what is possible"*.

The DERA Memorandum puts to rest any doubt that Precidian's 'stylized methodology' for VIIV cannot be reverse engineered. The claim by Messrs. McCabe and Criscitello of Precidian that their structure is immune to reverse engineering is patently false.

To that end, an active mutual fund manager considering using the Precidian ETF structure is by default, considering utilizing a transparent active ETF structure.

However, insofar that it will be 'transparent' to predatory traders, it will not trade efficiently for investors like currently approved transparent actively managed ETFs do because it's use of a third-party structure to facilitate creation, arbitrage and hedging means it will be less efficient in both the primary and secondary markets. In that light, better for the active mutual fund manager to simply opt for today's transparent active ETF structures already granted exemptive relief by the Commission.

Finally, from the work undertaken by DERA and Dr. Hayter, a basic 'recipe' for reverse engineering is now in the public domain:

1. Determine the size of the stock universe;

2. Overestimate the number of stocks expected in the fund (readily available from quarterly disclosures);

3. Determine if single or multi-day observations are needed;

4. Mathematically formulate the problem correctly;

5. Incorporate additional information gleaned from the fund's SAI or other public sources into the math e.g. fund turnover %, sector constraints etc.;

6. Run "artificial simulations' to fine tune the method using real data from the fund's previously disclosed portfolio information; and

7. Once the portfolio is "cracked", monitor over many trading days to detect the fund manager's strategy and habits and when actual trades occur.

I would also note that if an ETF fund using the Precidian structure also has a 'mirror' mutual fund then both funds are at risk of predatory front running.

Please refer to attached Exhibit One of this letter for an in-depth review of the DERA Memorandum by Dr. Hayter, along with a further improved method for reverse engineering.

Front Running

The traders with the quantitative skill set to reverse engineer are of course the same traders who will then bring their talents to predatory front running.

Who are they? They are the traders and strategists that work for hedge funds, proprietary trading desks and specialty trading houses, both domestically and off-shore. These traders combine capital markets savvy with graduate and doctorate level degrees in computer sciences, physics and mathematics. [13] These firms usually have unlimited computer resources at their disposal and their compensation models motivate traders to take risk and be aggressive.

The techniques outlined in the DERA Memorandum and by Dr. Hayter are trivial to these mathematically gifted individuals.

So once the portfolio has been "cracked" these traders will then develop techniques to take maximum advantage of the fund's trading patterns and strategy. Time is on the predatory traders' side – once the portfolio becomes visible they can sit back and fine tune their strategies before entering the market unobserved by the fund. They do not need to trade every day in front of the fund; they will do so only when profitable.

The DERA Memorandum and the work by Dr. Hayter clearly demonstrate that no fund using the Precidian ETF structure, regardless of the size of the fund or investable universe, can be certain that their undisclosed portfolio hasn't been subject to reverse engineering and that 'alpha' is being skimmed by a predatory trader.

I say this with tongue in cheek but a prospectus for funds using the Precidian ETF structure would have to include under the risk section language to the effect that, "*These funds are extremely vulnerable to predatory front-running which could negatively impact investor returns*".

Conclusion

In Mr. Criscitello's comment letter on the NYSE Arca, Inc. rule change application he notes a long list of potential investor benefits under a non-transparent ETF structure. [14] Ironically, what he doesn't document is evidence that investors want a retrogressive non-transparent investment structure. If the benefits Mr. Criscitello lists can be accrued in a much more transparent structure, why would anyone want to invest in a non-transparent 'black box'? Indeed, the success of the ETF market is built on the foundation of **transparency**. Why would approval of a wholly opaque, non-transparent ETF be innovative?

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[13] https://www.nytimes.com/2016/02/23/business/dealbook/a-new-breed-of-trader-on-wall-street-coders-with-a-phd.html (Note: this article is for reference only and no explicit or implicit suggestion is made that any of the firms or individuals profiled are assumed to undertake predatory trading activities)

[14] Note that Mr. Criscitello cannot claim that the Precidian ETF structure would accrue all these benefits since it can be readily reverse engineered and will have inefficient primary and secondary markets as described in letters Gary Gastineau, Simon Goulet and others submitted to the Commission.

Blue Tractor would always encourage the Commission to permit novel products that improve investor choice, fulfill a real product demand, enhance market efficiency and capital formation, overcome known financial obstacles through real innovation, while always maintaining the spirit and integrity of existing federal securities laws that promote 'fair markets' and provide investor protection. This last condition is inviolable.

Some market observers maintain that the Commission should approve every application it receives for novel ETF structures and 'should stand back and let the market decide' winners and losers. Interesting thought and so long as an application for a novel structure clearly meets the legal spirit of federal securities law to promote both 'fair markets' and investor protection, that could indeed be a viable approach.

However to recap, the Precidian ETF structure does not solve any investor demand for non-transparent products, it will do nothing to enhance market efficiency, it does not overcome any financial obstacles since it is highly vulnerable to reverse engineering (and therefore front-running) and the asymmetric disclosure of confidential portfolio information to privileged third parties clearly runs a foul of existing federal securities law. Therefore, the Precidian ETF structure cannot be viewed with the same lens as novel product applications that do meet all of these conditions.

Moreover, there is now confirmatory evidence from DERA that the Precidian ETF structure can be reverse engineered.

For these reasons, the Exchange's rule change application should be disapproved.

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Thank you in advance for your consideration of my commentary. I welcome any questions the Commission may have as a result and can be reached at [redacted].

Sincerely,

Terence W. Norman
Founder
Blue Tractor Group, LLC

EXHIBIT ONE

HayterStatistics.com

November 26th, 2017

Notes on the November 16th, 2017, Memorandum from the Division of Economic and Risk Analysis, entitled "Inferring Non-Transparent ETF Portfolio Holdings"

1. Overview.

These notes provide some comments on the November 16th, 2017, Memorandum from the Division of Economic and Risk Analysis (DERA) of the U.S. Securities and Exchange Commission, entitled "Inferring Non-Transparent ETF Portfolio Holdings".

The DERA Memorandum provides a generally perceptive and well thought-out discussion of the problem of reverse engineering a portfolio. The DERA Memorandum considers the analyses presented in several reports on this subject, and also presents some original simulation results of their own. The DERA Memorandum comes across as being a fair and unbiased assessment of the situation.

It is interesting to note that in the DERA Memorandum the problem is specified in exactly the same way that I specified it in my initial report "The Reverse Engineering of Portfolio Compositions", July 17th, 2017. The equation in the middle of page 1 of the DERA Memorandum is exactly identical to equation (1) on page 9 of my report, with exactly the same weights which sum to one.

The importance of setting up the problem correctly in the first place cannot be overstated. This is essential to the development of an algorithm that will successfully achieve reverse engineering. It should be pointed out that neither Ricky Cooper nor Lawrence Glosten provided this equation in their work, and they did not demonstrate that they had specified the problem correctly.

Obviously, a failed attempt at reverse engineering using a misspecified approach does not provide any illumination on the prospects of successfully achieving reverse engineering using a properly specified approach.

2. REO Analysis.

The REO approach is interesting in that it is based upon returns from one time increment to the next (using 10 second increments in this case), rather than being based on price levels. However, as the DERA Memorandum explains, this does not allow the precise estimation of what we are actually looking for. Consequently, this approach adds unnecessary difficulty and noise to the problem.

I agree with the DERA Memorandum that "Over multiple days, weight estimates based on returns will under-perform estimates based on price levels."

3. Ricky Cooper's Analysis.

I agree with the discussion in the DERA Memorandum concerning how the problem is set up. In the Cooper analysis the problem is poorly set up, so that it is estimating the wrong thing, with weights that do not sum to one.

I agree with the DERA Memorandum that this analysis and interpretation has "not fully accounting for the effects of scaling", and I agree with the DERA Memorandum that there are inherent difficulties with regressing on unscaled prices (as in the Cooper analysis) rather than on scaled prices, so that there are flaws in the operation and interpretation of the Cooper analysis.

4. Lawrence Glosten's Analysis.

I agree with the DERA Memorandum that "for the purpose of reverse engineering an ETF's portfolio holdings, small prediction errors are not the primary objective" and that with respect to LASSO "it is not obvious a priori that it should outperform OLS." In fact, I think that there are clearly limitations to taking any "off-the-shelf" package and applying it to the problem of reverse engineering a portfolio. Much more success is attainable with the development of an algorithm specifically for the reverse engineering problem at hand.

Again, I agree with the discussion in the DERA Memorandum concerning how the problem is set up. Again, as the DERA Memorandum explains, "Because the regressors are not scaled, the regression produces estimates of the number of shares of each security held." These are quantities which do not sum to one.

I think that the DERA Memorandum makes an important point in stating that "Therefore, it is possible that other LASSO implementations could achieve more accurate estimates of portfolio holdings." This is a recognition that any failed attempt at reverse engineering does not prove that all attempts must fail.

The DERA Memorandum confirms this by also stating that "Finally, Glosten's finding that OLS and LASSO are unable to accurately recover portfolio holdings for a larger universe of available portfolio securities (the Russell 1000) does not rule out the possibility that other techniques might perform better on stock universes of the same size."

5. Blue Tractor's Analysis.

This section of the DERA Memorandum comments on my initial report "The Reverse Engineering of Portfolio Compositions", July 17th, 2017. However, I issued a supplemental report on October 19th, 2017, which is not referred to in the DERA Memorandum.

The supplemental report considered more challenging scenarios than were considered in the initial report, and it provided further analyses to confirm that the reverse engineering of a portfolio is achievable with a substantial degree of accuracy.

Specifically, the differences between the analyses contained in the supplemental report and in my initial report are:

- Whereas the initial report only considered reporting of prices at time points 15-seconds apart, which provides 1,560 time points throughout a complete trading day, in the supplemental report the reporting of prices at time points 1-second apart is considered, which provides 23,400 time points throughout a complete trading day.
- Whereas the initial report considered a universe of $k = 100$ potential stocks, in the supplemental report the more challenging scenario of a universe of $k = 1{,}000$ potential stocks is considered. The reverse engineering of

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portfolios consisting of both 130 and 80 stocks out of this universe of k = 1,000 potential stocks is demonstrated.

- Finally, the implementation of more sophisticated multi-day reverse engineering methodologies is demonstrated in the supplemental report, which more closely model how a serious attempt at reverse engineering would be made in practice.

While it is correct that my analysis "uses a single 'average' correlation value across the simulated stock universe" as pointed out in the DERA Memorandum, I actually present worst-case, average, and best-case scenarios for the stock variabilities and correlations in an attempt to encompass real scenarios.

I note the recognition in the DERA Memorandum ("Hayter estimates the correct regression specification") of the importance of setting up the problem correctly.

As the DERA Memorandum notes, "Hayter uses a two-pass approach: the above regression is estimated, any stocks with statistically insignificant coefficients are removed from the universe, and the regression is re-estimated" and "Nonetheless, the two-pass aspect of his regression approach is an example of an alternative estimation technique that potentially improves upon the standard OLS and LASSO estimations above." I think this illustrates the advantages that can accrue from an algorithm designed specifically for the reverse engineering problem at hand.

In fact, the second stage of my approach is more of an optimization approach (constrained quadratic minimization problem) similar to the technique mentioned on page 8 of the DERA Memorandum ("posing the least-squares problem as a quadratic program"). Again, rather than taking any "off-the-shelf" package and applying it to the problem of reverse engineering a portfolio, this illustrates that more success is attainable with the development of an algorithm specifically for the reverse engineering problem at hand.

As the DERA Memorandum notes, "Hayter shows that with 5 days of data, he can reverse engineer portfolios in this small universe to a very high degree of accuracy: his weights are only off by an average of 0.000776 relative to the true portfolio weight of 0.025, exhibit very few false-positives, and never exclude a stock that is in the true portfolio." This demonstrated successful reverse engineering in this scenario with what I would consider a relatively simple and naïve algorithm.

The DERA Memorandum also notes "With only one day of data and 15 second VIIV increments, the results are less accurate, but this is much less data than the one second increments that Precidian's ETF structure would provide" and "On a larger universe with 1 second data, the results would probably lie somewhere in between these two extremes." I agree with these comments if the relatively simple and naïve algorithm used in my initial report were adopted. However, the more sophisticated multi-day reverse engineering methodologies illustrated in my supplemental report demonstrated successful reverse engineering for these more challenging scenarios.

I think it is also important to stress that, as pointed out in my reports, in practice it would be expected that experts with knowledge of the specific stocks involved, with some prior historical information about the portfolio, and with an understanding of prevailing market conditions, for example, would be able to fine-tune any methodology in order to substantially improve its performance.

6. DERA Simulations.

The DERA Memorandum contains an important observation: "Any success in reverse-engineering the portfolio weights should therefore be considered a lower bound on what is possible." Similarly, if an attempt at reverse engineering is made which turns out to be unsuccessful, then this in no way shows that reverse engineering cannot be done. It should not be forgotten that all of the analyses of reverse engineering that have been performed so far only provide a "lower bound" on what a determined approach at reverse engineering could achieve.

The DERA simulations provide further useful insights into the reverse engineering problem, and since like REO they are using returns, which is not the best specification, and which adds difficulty and noise to the problem, it is clear that their results could be improved upon.

I agree with the findings of the DERA simulations that:

- "the effectiveness of reverse engineering decreases as the size of the universe increases"

- "funds that invest in a larger fraction of the universe are harder to reverse engineer"
- "algorithms perform better with more observations relative to the universe size".

Finally, I like the ingenuity and insight that "DERA was able to improve estimation results using the fact that each error term ε_t is a result of rounding to the nearest penny, so $\$-0.005 < \varepsilon_t < \$0.005$ for all t" so that they find benefit by "posing the least-squares problem as a quadratic program". This illustrates the fact that an ingenious and determined protagonist will be able to fine-tune any methodology in order to substantially improve its performance.

7. New Results.

Tables 1.1-2.3 present new simulation results that demonstrate a new improved algorithm for conducting reverse engineering. The tables presented here are updated versions of Tables 1.1-2.3 contained within my supplemental report of October 19th, 2017.

A portfolio of 130 stocks out of a potential universe of 1,000 stocks is considered, with a scaled portfolio price of 50 (Tables 1.1-1.3) and 30 (Tables 2.1-2.3), and with the reporting of prices at time points 1-second apart. In all cases, in addition to the scaling of the portfolio price, "shielding" of the portfolio is achieved by rounding the portfolio price to r = 2 decimal places (in other words, to the nearest penny). Furthermore, as discussed in my supplemental report, three scenarios of the daily stock volatilities σ_d and correlations ρ are considered.

The results presented here use an improved version of the sophisticated multi-day reverse engineering methodology illustrated in my supplemental report. Specifically, similarly to the approach discussed and adopted in the DERA simulations, a quadratic programming minimization algorithm with constraints was implemented, which makes full use of the fact that the weights are positive and sum to one, and which can also make use of the known bounds on the errors as pointed out by DERA.

I have used metrics which I think most clearly demonstrate the effectiveness of the reverse engineering, namely:

- Number of stocks incorrectly excluded from the estimated portfolio.

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- Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.
- Number of stocks incorrectly included in the estimated portfolio.
- Sum of estimated weights for stocks incorrectly included in the estimated portfolio.

For completeness, I have also included the standard Pearson correlation coefficient and the Spearman rank correlation coefficient between the true weights and the estimated weights.

The results presented in Tables 1.1-2.3 clearly show the success of the reverse engineering, and they also have a substantial improvement over the results presented in my supplemental report. This illustrates the important point that there is always the potential to provide a new insight that can lead to the improvement of a reverse engineering methodology simply by formulating the algorithm slightly differently.

Anthony Hayter, Ph.D.

HayterStatistics.com

November 26th, 2017

Table 1.1						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 50. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Worst-case scenario for daily volatility and correlations: σ_d = 0.0137 and ρ = 0.551.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	1.9	0.0015	4.0	0.0165	0.96	0.98
Day 2	0.0	0.0010	0.1	0.0003	0.98	1.00
Day 3	0.0	0.0009	0.0	0.0000	0.99	1.00
Day 4	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 5	0.0	0.0007	0.0	0.0000	0.99	1.00
Day 6	0.0	0.0006	0.0	0.0000	0.99	1.00
Day 7	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 8	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 9	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 10	0.0	0.0005	0.0	0.0000	1.00	1.00
Portfolio weights change day to day.						
Day 1	1.0	0.0015	3.3	0.0138	0.98	0.96
Day 2	0.0	0.0010	0.2	0.0007	1.00	0.98
Day 3	0.0	0.0008	0.0	0.0000	1.00	0.99
Day 4	0.0	0.0007	0.0	0.0000	1.00	0.99
Day 5	0.0	0.0007	0.0	0.0000	1.00	0.99
Day 6	0.0	0.0006	0.0	0.0000	1.00	0.99
Day 7	0.0	0.0006	0.0	0.0000	1.00	0.99
Day 8	0.0	0.0006	0.0	0.0000	1.00	1.00
Day 9	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 10	0.0	0.0005	0.0	0.0000	1.00	1.00

Table 1.2						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 50. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Average scenario for daily volatility and correlations: $\sigma_d = 0.0173$ and $\rho = 0.278$.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	0	0.0009	0	0.0000	0.99	1.00
Day 2	0	0.0006	0	0.0000	0.99	1.00
Day 3	0	0.0005	0	0.0000	1.00	1.00
Day 4	0	0.0004	0	0.0000	1.00	1.00
Day 5	0	0.0004	0	0.0000	1.00	1.00
Day 6	0	0.0004	0	0.0000	1.00	1.00
Day 7	0	0.0003	0	0.0000	1.00	1.00
Day 8	0	0.0003	0	0.0000	1.00	1.00
Day 9	0	0.0003	0	0.0000	1.00	1.00
Day 10	0	0.0003	0	0.0000	1.00	1.00
Portfolio weights change day to day.						
Day 1	0	0.0009	0	0.0000	0.99	1.00
Day 2	0	0.0006	0	0.0000	0.99	1.00
Day 3	0	0.0005	0	0.0000	1.00	1.00
Day 4	0	0.0005	0	0.0000	1.00	1.00
Day 5	0	0.0004	0	0.0000	1.00	1.00
Day 6	0	0.0004	0	0.0000	1.00	1.00
Day 7	0	0.0004	0	0.0000	1.00	1.00
Day 8	0	0.0004	0	0.0000	1.00	1.00
Day 9	0	0.0004	0	0.0000	1.00	1.00
Day 10	0	0.0004	0	0.0000	1.00	1.00

Table 1.3						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 50. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Best-case scenario for daily volatility and correlations: σ_d = 0.0237 and ρ = 0.181.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	0	0.0006	0	0.0000	1.00	1.00
Day 2	0	0.0004	0	0.0000	1.00	1.00
Day 3	0	0.0003	0	0.0000	1.00	1.00
Day 4	0	0.0003	0	0.0000	1.00	1.00
Day 5	0	0.0003	0	0.0000	1.00	1.00
Day 6	0	0.0002	0	0.0000	1.00	1.00
Day 7	0	0.0002	0	0.0000	1.00	1.00
Day 8	0	0.0002	0	0.0000	1.00	1.00
Day 9	0	0.0002	0	0.0000	1.00	1.00
Day 10	0	0.0002	0	0.0000	1.00	1.00
Portfolio weights change day to day.						
Day 1	0	0.0006	0	0.0000	1.00	1.00
Day 2	0	0.0004	0	0.0000	1.00	1.00
Day 3	0	0.0003	0	0.0000	1.00	1.00
Day 4	0	0.0003	0	0.0000	1.00	1.00
Day 5	0	0.0003	0	0.0000	1.00	1.00
Day 6	0	0.0003	0	0.0000	1.00	1.00
Day 7	0	0.0003	0	0.0000	1.00	1.00
Day 8	0	0.0003	0	0.0000	1.00	1.00
Day 9	0	0.0003	0	0.0000	1.00	1.00
Day 10	0	0.0003	0	0.0000	1.00	1.00

Table 2.1						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 30. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Worst-case scenario for daily volatility and correlations: σ_d = 0.0137 and ρ = 0.551.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	36.4	0.0039	36.6	0.2052	0.71	0.69
Day 2	19.9	0.0032	15.2	0.0701	0.83	0.85
Day 3	8.3	0.0023	9.2	0.0387	0.91	0.93
Day 4	5.7	0.0020	4.3	0.0163	0.93	0.96
Day 5	5.4	0.0019	0.9	0.0032	0.94	0.97
Day 6	0.8	0.0015	0.7	0.0026	0.96	0.99
Day 7	1.1	0.0014	0.2	0.0007	0.97	0.99
Day 8	2.1	0.0014	0.0	0.0000	0.97	0.99
Day 9	0.3	0.0013	0.1	0.0003	0.98	1.00
Day 10	0.1	0.0012	0.0	0.0000	0.98	1.00
Portfolio weights change day to day.						
Day 1	35.3	0.0039	35.6	0.1993	0.71	0.70
Day 2	19.2	0.0032	11.8	0.0548	0.84	0.87
Day 3	7.7	0.0022	9.5	0.0398	0.91	0.93
Day 4	4.1	0.0019	3.4	0.0141	0.94	0.97
Day 5	5.0	0.0019	1.5	0.0056	0.94	0.97
Day 6	1.2	0.0015	1.8	0.0067	0.96	0.98
Day 7	1.3	0.0015	0.5	0.0018	0.97	0.99
Day 8	2.1	0.0015	0.2	0.0006	0.97	0.99
Day 9	0.2	0.0013	0.3	0.0010	0.98	0.99
Day 10	0.2	0.0012	0.1	0.0003	0.98	0.99

Table 2.2						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 30. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Average scenario for daily volatility and correlations: σ_d = 0.0173 and ρ = 0.278.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	13.9	0.0026	13.1	0.0629	0.87	0.89
Day 2	3.4	0.0017	2.7	0.0100	0.95	0.97
Day 3	1.0	0.0014	0.6	0.0022	0.97	0.99
Day 4	0.1	0.0012	0.1	0.0003	0.98	1.00
Day 5	0.0	0.0010	0.0	0.0000	0.98	1.00
Day 6	0.0	0.0009	0.0	0.0000	0.99	1.00
Day 7	0.0	0.0009	0.0	0.0000	0.99	1.00
Day 8	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 9	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 10	0.0	0.0007	0.0	0.0000	0.99	1.00
Portfolio weights change day to day.						
Day 1	14.0	0.0025	12.8	0.0636	0.87	0.89
Day 2	1.8	0.0017	3.4	0.0132	0.95	0.98
Day 3	0.6	0.0014	0.9	0.0032	0.97	0.99
Day 4	0.0	0.0012	0.2	0.0007	0.98	1.00
Day 5	0.0	0.0010	0.0	0.0000	0.98	1.00
Day 6	0.0	0.0010	0.0	0.0000	0.99	1.00
Day 7	0.0	0.0009	0.0	0.0000	0.99	1.00
Day 8	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 9	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 10	0.0	0.0008	0.0	0.0000	0.99	1.00

Table 2.3						
Universe of k = 1,000 potential stocks. Portfolio initially contains 130 stocks with equal weights 1/130.						
Initial scaled value of a portfolio share = 30. Portfolio share price rounded to r=2 decimal places.						
1-second reporting (23,400 values per day).						
Best-case scenario for daily volatility and correlations: $\sigma_d = 0.0237$ and $\rho = 0.181$.						
Table entries are average values based on M = 10 simulations.						
	Number of stocks incorrectly excluded from the estimated portfolio.	Average absolute difference between true weight and estimated weight for the 130 stocks in the portfolio.	Number of stocks incorrectly included in the estimated portfolio.	Sum of estimated weights for stocks incorrectly included in the estimated portfolio.	Pearson correlation between true weights and estimated weights.	Spearman rank correlation between true weights and estimated weights.
Portfolio weights unchanged.						
Day 1	1.0	0.0014	2.4	0.0097	0.97	0.98
Day 2	0.0	0.0009	0.1	0.0003	0.99	1.00
Day 3	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 4	0.0	0.0007	0.0	0.0000	0.99	1.00
Day 5	0.0	0.0006	0.0	0.0000	0.99	1.00
Day 6	0.0	0.0006	0.0	0.0000	1.00	1.00
Day 7	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 8	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 9	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 10	0.0	0.0004	0.0	0.0000	1.00	1.00
Portfolio weights change day to day.						
Day 1	0.7	0.0014	1.7	0.0070	0.97	0.99
Day 2	0.0	0.0010	0.1	0.0003	0.99	1.00
Day 3	0.0	0.0008	0.0	0.0000	0.99	1.00
Day 4	0.0	0.0007	0.0	0.0000	0.99	1.00
Day 5	0.0	0.0006	0.0	0.0000	0.99	1.00
Day 6	0.0	0.0006	0.0	0.0000	0.99	1.00
Day 7	0.0	0.0006	0.0	0.0000	1.00	1.00
Day 8	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 9	0.0	0.0005	0.0	0.0000	1.00	1.00
Day 10	0.0	0.0005	0.0	0.0000	1.00	1.00