OPTURO, INC.

CHALLENGES INVOLVED IN BUILDING AN EX-POST PERFORMANCE AND ATTRIBUTION APPLICATION

| investment process automation |

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BUILDING A ROBUST EX-POST PERFORMANCE AND ATTRIBUTION SYSTEM INVOLVES A NUMBER OF DIFFICULT CHALLENGES.

It requires careful attention to a number of particular considerations and their convoluted interactions in order to consistently provide economically meaningful results, as opposed to reproducing misleading formally motivated calculations that are hidden behind familiar sounding names. These considerations include:

Flows Impacting Returns

- **External flows**: Correctly implement their timely impact on time-weighted and money-weighted returns, and on fee accruals.
- **Trades**: Avoid the inconsistencies and degeneracies created by standard Dietz return calculations. This includes ensuring that weights at any level always sum to exactly one at the portfolio level, that component gross and net daily returns at any level roll up exactly to the portfolio return and avoiding inappropriately large component-level daily returns.
- Properly account for the trading of products whose analysis involves their notional values.
- **Accruals**: Beside accruing dividends and coupons with careful attention to trade and settlement dates, properly accrue both fee assessments and their payment, whether they are to be applied to a restricted set or portfolio-wide, and in a manner such that daily net returns compound to imply the correct exact fee for the period.

Other Return Effects and Types

- **Temporal compounding:** Implement in a way that maintains the proper financial meanings carried over from single period terms, rather than in a manner that skews the evaluation of properties by the distribution of compounding errors, which are never necessary in a correct analysis. Always avoid creating errors, and thus avoid having these errors warp the information from evaluations, especially for all contributions and attributes.
- **FX rates:** Correctly assign their timing and their impact, such as by the consistent and unrestricted application of the insights of Karnosky/Singer to all currency-dependent calculations.
- Properly incorporate and exhibit differences between market results and actual trade-inclusive fund experiences, for such values as prices, FX rates and yields.
- Leverage, including notional products, Shorting, or other investments or corporate actions with a zero or negative basis: Avoid the possibility of assigning inappropriately large or infinite returns, such as for futures (even if uncollateralized) and other outright bets.
- **Illiquids:** Appropriately extend the periodicity of returns and volatility.
- **IRR:** Correct the standard approaches to internal rate of return when applied to actual or implied short positions.
- **Annualization:** Reflect that the annualization of an arithmetic difference is not the arithmetic difference of annualizations.

Attribution

- **Bucketing:** Avoid discontinuous results (large jumps in evaluated terms) caused by infinitesimal changes that might take one across a boundary.
- **Universality:** Models constructed to evaluate universal properties, such as returns and attributes are properly universally applicable. Thus, return calculations should equally correctly apply to vanilla instruments, to illiquids and to derivatives. All attribution models should equally correctly apply to equity, fixed, illiquid and derivative products and to any of their portfolio mixtures. It should also be the case that the attribution to the uncontrollable market effects and to controllable investment decisions are available in a perfectly commensurate, rather than in a confused intermingled manner, not only for the explanation of the sources of measures such as returns but for all risk and risk-adjusted return measures. Especially since the combined and consistent analysis of risk with return is the primary mandate following from modern portfolio theory. Separate models for fixed and equity investments belies the truth that the option to invest in any of these assets always comes together in the choices open to all investors.
- **Avoiding category confusions:** All these issues must be addressed while keeping carefully clear the distinction between ex-post and ex-ante considerations and between uncontrollable market and controllable investment decision characteristics.
- Properly recognize the possible difference in the pricing of the fund and the benchmark.

Data Management & Reporting

- Be able to incorporate and deploy information in any format, and in processes independent of the calculation engine.
- Provide the ability to pre-process any information available at any level of structure, such as the creation from their possible sources of all standard input values or the creation of variously extrapolated yield curves and other fixed income properties from key bonds.
- Automate the on-boarding of overrides and new flow, trade and settlement types.
- Provide automatic multi-level drill down capabilities for fund of funds and derivatives with multiple legs.
- Allow inputs and reporting to be denominated in returns, quantities or market values.
- Report at any inclusive or exclusive level of gross and net results.

To even be able to strive after reliability, it is incumbent for all performance, attribution and risk systems that it be definitively ascertained whether they avoid deficiencies in any of these areas. Risk assessment and remediation begins with our evaluative tools, including that they only consider properly formulated financial questions and then respond to them coherently.

If ex post performance, attribution and risk models are built on unsound foundations, then we will be unknowingly blind to the actual risks our investments faced and subsequent investment processes will be misled into making investment decisions based upon erroneous historical information. Alpha should never be lost to avoidable model risk or operational deficiencies.