



CASE STUDY:
**Building A Custom “Low Volatility” Investment
Strategy Using Artificial Intelligence (A.I.)**

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CASE STUDY: Designing A Hyper-Custom “Low Volatility” Investment Strategy Using Artificial Intelligence (A.I.)

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We recently collaborated with a Chief Investment Officer (CIO) who oversees a substantial portfolio of stocks, bonds, and credit investments for a prominent family office. Our mission was to design a personalized A.I. investment strategy that would not only enable him to monitor the A.I.'s investment decisions but also measure its performance against his own. With the CIO's extensive experience in the field, our team worked diligently to develop a custom solution that met his and his family's unique “low volatility” needs. *Note: This particular portfolio is tax-exempt.*

The CIO provided us with the following investment targets:

Target Returns:	5%+ net annually
Risk (Volatility):	5% (conservative)
Stock Allocation:	80 U.S. and Europe stocks, 25% of the portfolio on average
US:	20%
Europe:	5%
Bond Allocation:	Government bonds and investment grade credit, 75% of the portfolio on average
Governments:	40%
IG Corporate Credit:	35%
Maximum Drawdown:	-10%
Re-Balancing:	Weekly

The investment process begins with a development roadmap for researching and testing a customized investment strategy. We draw data from the ETS Data Lake, a repository of meticulously cleaned and prepared data, ratios, and factors, as well as an inventory of proprietary systems and tools. This enables us to create a tailored universe of securities with high-quality data streams and consistent fundamental ratios across markets, sectors, and companies.

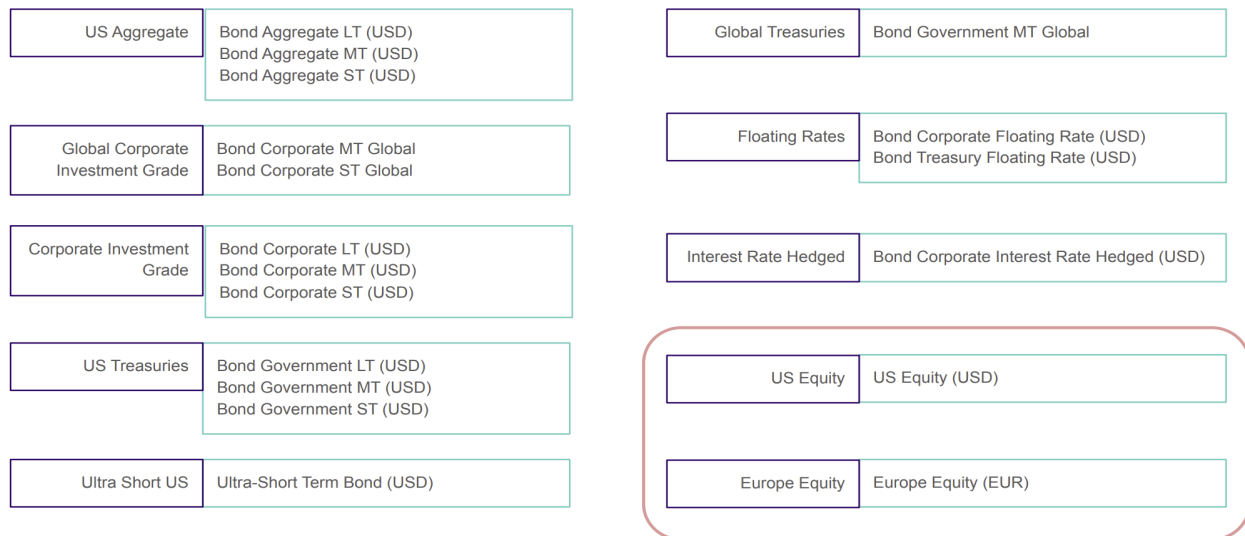
Next, our team of data scientists trains the A.I. model to trade the strategy, using sophisticated tools and techniques to fight data bias and model overfitting, while eliminating securities with fundamental or behavioural anomalies. The A.I. model then scores and ranks all securities in the universe based on current market patterns and features, issuing the first trade recommendation of securities to purchase.

The final stage involves implementing and monitoring the portfolio, using models to control for unnecessary trading, and monitor transaction costs and corporate events like dividends or stock splits. The system continuously watches for adverse changes to fundamental ratios such as rising debt levels or balance sheet deterioration (e.g., Silicon Valley Bank).

The A.I. model reanalyses markets and companies daily, looking for important changes in patterns and features, and re-scores each security. Trades are typically issued weekly, although more complex strategies like long-short may require daily trading. Our goal is to maximize risk-adjusted returns and other portfolio targets for each individual investor using cutting-edge A.I. technology and a data-driven approach.

Custom Universe: 18 Categories of Securities

The first step is to define the investment universe of potential securities based on the target index and its component parts. Here, after discussion with our client, we narrowed the universe down from 45 potential stock and bond categories to 18.



The US Equity and Europe Equity categories includes individual stocks from the S&P 500 Index and the MSCI Europe Index respectively, while the bonds and credit categories utilize ETFs.

A Conservative Strategy: 25% Stocks and 75% Bonds and Credit

When creating a new hyper-custom investment strategy for the first time, the initial R&D phase normally takes from two weeks to 90 days, depending on complexity. During that time a team of data scientists test many portfolio variations and train the A.I. to continuously seek “optimal” performance. This particular portfolio had several rounds of changes with the investor and took approximately 30 days to develop.

When the team is satisfied with the research results, we share the recommended portfolio simulation with our investor to illustrate potential performance, risk, exposures, holdings, and other factors. Since this is a customized investment solution and not an "off the shelf" fund with an established return history, we must rely on simulated performance and risk. While not actual portfolio results, investors must generally accept this risk when creating a new bespoke investment strategy. To try to make the simulation as useful as possible, our data-driven approach incorporates tools and techniques to fight data bias, survivorship bias, and model overfitting. Our goal is to gather useful insight into the strategy's overall utility and risks.

Please read Important Disclosures at the end of this article about the potential limitations or risks of hypothetical performance.

Our A.I. research partner, ETS, brings investment models with track records dating back as far as 1997¹. Here, however, we are using the IDDI equity model which first went live in 2013². The IDDI model suggests our client's “low volatility” strategy may meet, or come close to, many of his goals including potentially beating the benchmark in terms of returns, maximum drawdown, and Sharpe ratio. The simulation exhibits a slightly higher annual volatility, but it is close to the target. Separately, the maximum drawdown (MDD) is slightly above -10% but is close to the target. The worst calendar year simulation was 2022 with a decline of -4.74%.

¹ Source: EST, Mutua Vida registered Unit Linked Dynamic Fund from 12/26/1997

² Source: ETS, IDDI US real track from 12/10/2013

Portfolio Simulation Output:



	Proposal	Benchmark
Annualized return	5.58%	3.86%
Annualized volatility	6.28%	5.07%
Maximum DD	-12.60%	-15.72%
Sharpe ratio	0.89	0.77
Turnover	6.03	—
Number of lines	9.20	—

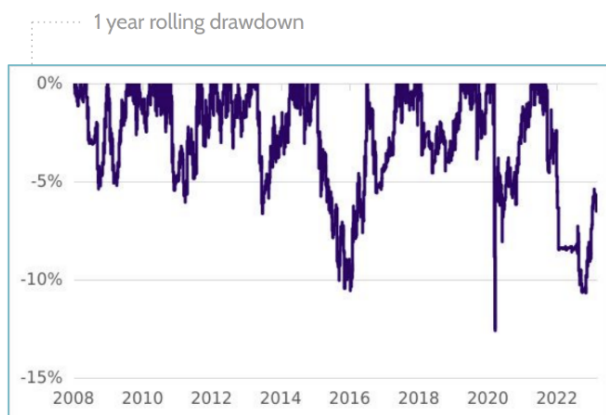
Returns	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023*
Proposal	1.88%	5.30%	10.66%	10.15%	6.07%	3.42%	11.35%	-4.64%	6.31%	10.91%	-0.59%	15.99%	8.36%	5.18%	-4.74%	2.85%
Benchmark	-9.01%	13.48%	7.05%	1.91%	6.42%	7.39%	3.99%	1.44%	4.69%	5.96%	-0.04%	11.54%	8.02%	5.99%	-8.41%	6.61%

* Benchmark : 75% iShares Core 1-5 Y Bond ETF - 20% S&P 500 - 5% MSCI Europe

Portfolio simulation results from 01/01/2007 to 3/1/2023. Figures related to past performances and/or hypothetical performances and/or forward-looking statements and are not reliable indicators of future results. See Important Disclosures at the end of this document about the risks of simulated or hypothetical performance and forward-looking statements. Assumes 0.60% in fees, 5 bps trading, and 0% risk free rate.

Volatility and Max Drawdown: Close To -10% and 5% Targets

Below we see the simulated rolling MDD generally meeting its target but slightly exceeds it in 2020 by -2.60%. The volatility also remained consistent aside from a temporary spike in 2020. This seems reasonable to our client and us.

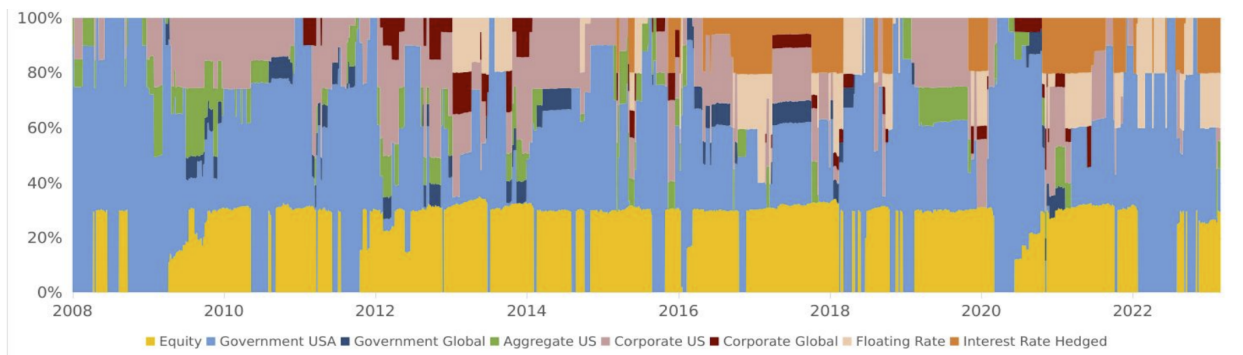


Portfolio simulation results from 01/01/2007 to 3/1/2023. Figures related to past performances and/or hypothetical performances and/or forward-looking statements and are not reliable indicators of future results. See Important Disclosures at the end of this document about the risks of simulated or hypothetical performance and forward-looking statements. Assumes 0.60% in fees, 5 bps trading, and 0% risk free rate.

Overall, given our client’s goals, we are pleased with the “low volatility” strategy.

Asset Class Exposure: **Currently Stocks, Ultra-Short, Rate-Hedged, and Floating Rate**

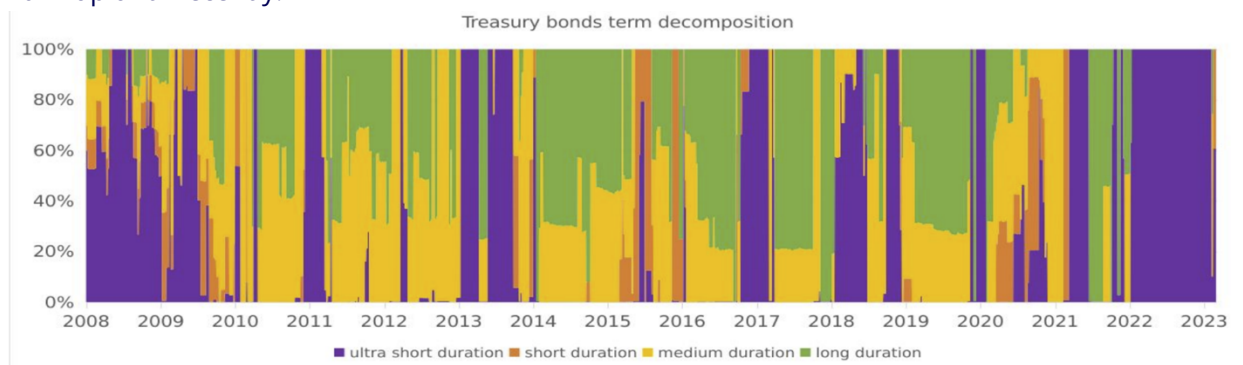
The system self-adapts from the bottom up, re-scoring stocks and ETFs to reflect changing company, fund, and market measurables, behaviours, and patterns. Here, we see stocks average around 30%, with a floor of 0%. Treasuries average 45% but can grow to 100% of the portfolio during times of market stress. Corporate bonds average 14% but can increase to 41%. As of the date of the simulation, March 1, the portfolio was fully invested in stocks and ultra-short, floating rate, and interest rate hedged bonds.



	Equity	Government US	Government Global	Aggregate US	Corporate US	Corporate Global	Floating Rates	Interest Rate Hedged
On Average	22.29%	45.21%	2.32%	4.72%	13.94%	2.07%	4.95%	4.51%
Maximum weight	35.08%	100%	8.33%	25.45%	41.11%	15.45%	40.15%	20.58%

Treasury Bond Duration: **Currently Ultra-Short and Short**

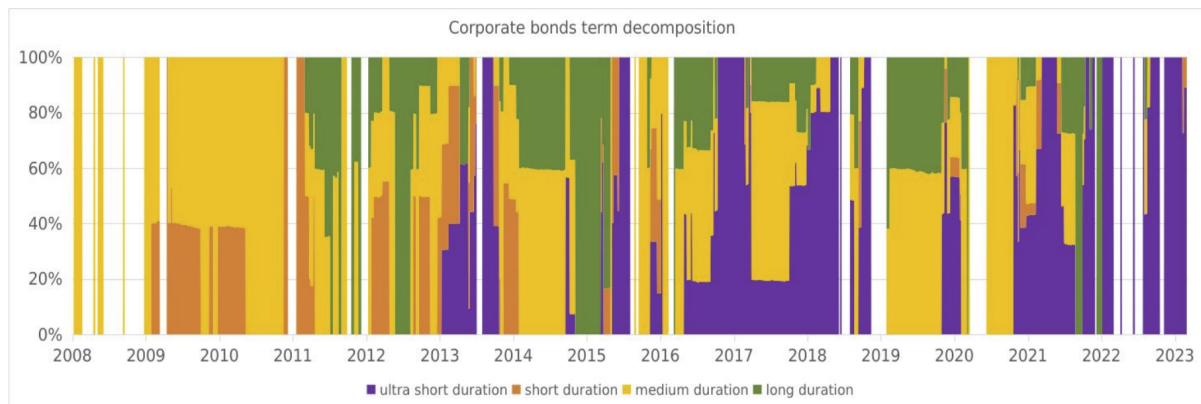
One of our portfolio mandates is to try to limit the size of the maximum drawdown or calendar year losses to -10%. Therefore, in times of uncertainty or risk, the system will allocate up to 100% of the portfolio to less-volatile ultra-short and short duration Treasury ETFs, to try to limit portfolio drawdowns to single digits. Therefore, we see the entire Treasury allocation was ultra-short for all of 2022 up until recently.



	Ultra Short Duration	Short Duration	Medium Duration	Long Duration
On Average	18.55%	3.63%	16.15%	14.71%
Maximum weight	100%	59.53%	67.74%	35.31%

Corporate Bond Duration: **Currently Ultra-Short**

Unlike with Treasuries, the portfolio may not always have an exposure to corporate bonds. Instead, on average, we tend to see more variability between long, medium, short, ultra-short, and no exposure, depending on the market environment, i.e., the risk of rising interest rates or inflation. More recently, the system recommended either zero (0%) credit exposure or ultra-short duration credit exposure.

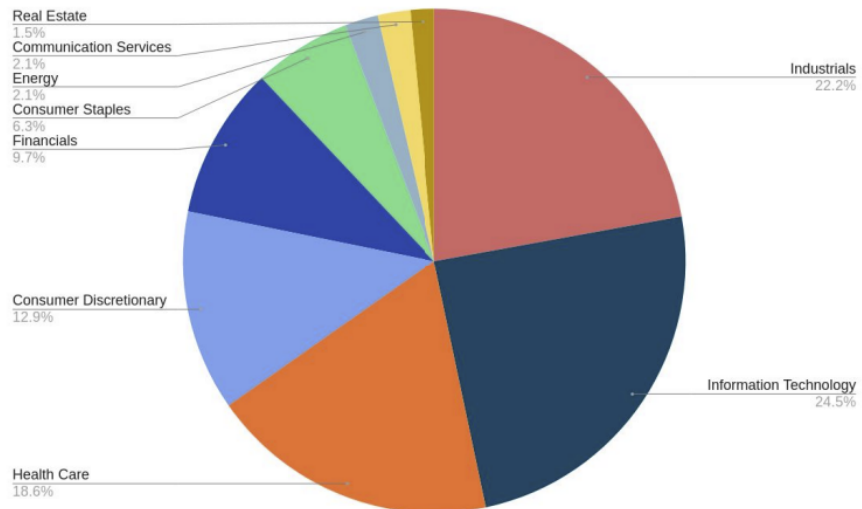


	Ultra Short Duration	Short Duration	Medium Duration	Long Duration
On Average	8.67%	3.57%	8.61%	3.83%
Maximum weight	40.92%	25.49%	20.68%	10.93%

Recommended Holdings: **As of March 1, 2023**

Please note: The A.I. model may substantially change the portfolio holdings relatively quickly without advance notice. Readers should not draw any investment conclusions from the holdings which are shown for instructive purposes only.

The portfolio mandate was to hold, on average, 80 individual stocks and 8-10 Treasury and corporate ETFs. The stocks were to be divided on average between 20% US and 5% Europe. Currently, the bond allocation is roughly equal with both emphasizing shorter durations and floating rate and interest rate-hedged positions. This implied the system saw market patterns, as of the time of the analysis, of continued inflation and/or rising interest rates.



Recommended Portfolio Holdings: As of March 1, 2023

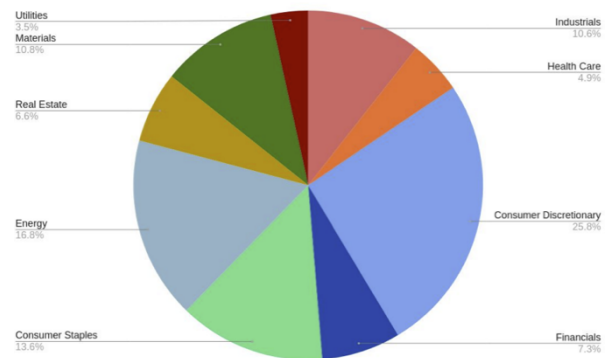
Equity	
Europe	6.13%
USA	23.29%
Fixed Income Treasuries	
JP Morgan UltraShort Income ETF Dis XNYS	5.50%
iShares UltraShort Term Bond ETF Dis XNYS	10.09%
iShares Short Maturity Bond ETF Dis XCBT	10.09%
First Trust Enhanced Short Maturity ETF Dis XNAS	4.85%
Fixed Income Corporates	
Invesco Variable Rate Investment Grade ETF Dis XNAS	10.01%
ProShares Investment Grade-Interest Rate Hedged ETF Dis XCBO	10.03%
iShares Interest Rate Hedged Corporate Bond ETF Dis XNYM	9.97%
VanEck Vectors-Investment Grade Floating Rate ETF Dis XNYS	10.03%
	100%

Recommended US Equities: As of March 1, 2023

name	weight	category/sector	weight	name	weight	category/sector	weight
Alphabet A XNAS	0.49%	Communication Services	0.49%	W W Grainger XNYS	0.57%	Industrials	
NVR XNYS	0.58%	Consumer Discretionary		Illinois Tool Works XNYS	0.53%	Industrials	
Booking Holdings XNAS	0.53%	Consumer Discretionary		CH Robinson Worldwide XNAS	0.48%	Industrials	
Ulta Salon Cosmetics and Fragr XNAS	0.51%	Consumer Discretionary	3.01%	Expeditors International of Wa XNAS	0.48%	Industrials	
Tapestry XNYS	0.49%	Consumer Discretionary		Union Pacific XNYS	0.47%	Industrials	
PulteGroup XNYS	0.47%	Consumer Discretionary		Robert Half International XNYS	0.46%	Industrials	5.16%
D.R. Horton XNYS	0.43%	Consumer Discretionary		Copart XNAS	0.46%	Industrials	
Hershey XNYS	0.59%	Consumer Staples		Fastenal XNAS	0.44%	Industrials	
Colgate-Palmolive XNYS	0.44%	Consumer Staples	1.46%	Rollins XNYS	0.44%	Industrials	
Brown-Forman B XNYS	0.43%	Consumer Staples		Cintas XNAS	0.43%	Industrials	
Coterra Energy XNYS	0.50%	Energy	0.50%	Verisk Analytics A XNAS	0.38%	Industrials	
Ameriprise Financial XNYS	0.49%	Financials		Broadcom XNAS	0.52%	Information Technology	
Discover Financial Services XNYS	0.47%	Financials		Paychex XNAS	0.51%	Information Technology	
CME Group XNAS	0.46%	Financials	2.27%	Gen Digital XNAS	0.46%	Information Technology	
S&P Global XNYS	0.44%	Financials		Apple XNAS	0.46%	Information Technology	
Principal Financial Group XNAS	0.42%	Financials		Visa A XNYS	0.46%	Information Technology	
Amgen XNAS	0.59%	Health Care		Microsoft XNAS	0.46%	Information Technology	
Eli Lilly XNYS	0.54%	Health Care		Automatic Data Processing XNAS	0.45%	Information Technology	5.71%
Regeneron Pharmaceuticals XNAS	0.52%	Health Care		NetApp XNAS	0.45%	Information Technology	
Merck & Co XNYS	0.52%	Health Care		MasterCard A XNYS	0.43%	Information Technology	
Waters XNYS	0.49%	Health Care	4.33%	Keysight Technologies XNYS	0.41%	Information Technology	
AbbVie XNYS	0.45%	Health Care		Cisco Systems XNAS	0.40%	Information Technology	
Vertex Pharmaceuticals XNAS	0.45%	Health Care		Texas Instruments XNAS	0.37%	Information Technology	
Zoetis A XNYS	0.44%	Health Care		Fleetcor Technologies XNYS	0.33%	Information Technology	
Pfizer XNYS	0.33%	Health Care		Public Storage XNYS	0.36%	Real Estate	0.36%

Recommended Europe Equities: As of March 1, 2023

name	weight	category/sector	weight
Ferrari XMIL	0.27%	Consumer Discretionary	
LVMH Moet Hennessy Louis Vuit XPAR	0.27%	Consumer Discretionary	
Industria de Diseño Textil XMAD	0.24%	Consumer Discretionary	1.41%
Hugo Boss XETR	0.23%	Consumer Discretionary	
Hermes International XPAR	0.21%	Consumer Discretionary	
La Francaise des Jeux XPAR	0.18%	Consumer Discretionary	
L'Oreal XPAR	0.22%	Consumer Staples	
Viscofan XMAD	0.18%	Consumer Staples	0.74%
Remy Cointreau XPAR	0.18%	Consumer Staples	
Kerry Group A XDUB	0.17%	Consumer Staples	
Eni XMIL	0.24%	Energy	
Repsol XMAD	0.20%	Energy	
TotalEnergies XPAR	0.18%	Energy	
Galp Energia SGPS B XLIS	0.16%	Energy	
Neste XHEL	0.14%	Energy	0.0092
Banco Bilbao Vizcaya Argentari XMAD	0.24%	Financials	
FinecoBank Banca Fineco XMIL	0.16%	Financials	0.40%
Ipsen XPAR	0.27%	Health Care	0.00269
Wolters Kluwer XAMS	0.23%	Industrials	
ACS XMAD	0.20%	Industrials	0.58%
Kone B XHEL	0.15%	Industrials	
Wienerberger XWBO	0.21%	Materials	
Recordati Industria Chimica e XMIL	0.20%	Materials	0.59%
ArcelorMittal A XAMS	0.17%	Materials	
Inmobiliaria Colonial SOCIMI XMAD	0.21%	Real Estate	0.36%
Cofinimmo XBRU	0.16%	Real Estate	
Endesa XMAD	0.19%	Utilities	0.19%



After analysing the data, we believe that this low volatility investment strategy can help our CIO client achieve many of his goals, which include outperforming his benchmark over the long term, limiting the maximum drawdown, tracking weekly investment changes made by the A.I., and assessing his own performance against the A.I.

The role of a CIO is challenging and time-consuming, with many uncertainties. By combining our raw computing power, A.I. identification of market drivers, and daily security scoring and ranking with the CIO's insights into portfolio strategy, goals, and risk levels, we aim to simplify the process and enable him to achieve his desired results more easily and efficiently. We believe this approach can save him significant time, allowing him to better focus on higher-value priorities.

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Lumenai was granted use of the hypothetical returns by our third-party quantitative/AI research partner(s). Hypothetical results do not represent the results of actual trading using client assets and were achieved by means of the retroactive application of a hypothetical model that was designed with the benefit of hindsight and could be adjusted at will until desired or better performance results were achieved. No representation is being made

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