

The Nitrogen GPA[®]

From Academic Theory to Practical Application

NITROGEN WHITE PAPER

The Nitrogen GPA

Nitrogen, coupled with a Nobel Prize® winning academic's theory¹ and sophisticated proprietary enhancements, created a practical investment performance efficiency metric. The Nitrogen GPA provides significant utility for investment selection at the individual holding, model, account, or strategy level. This intuitive metric highlights the efficiency of an investment, powers an objective and quantifiable means of comparing investments, and can be used as an input for multi-factor analysis.

What does the Nitrogen GPA acronym mean?

One of the primary goals of Nitrogen GPA is to improve on existing academic frameworks by providing both a clever and practical approach with the addition of an academic grading scale. "GPA" stands for "grade point average" which is an academic term most American high schools and universities use to benchmark student learning efficiency. Nitrogen borrows this well-established terminology to express this risk-adjusted return metric, The Nitrogen GPA. The higher the GPA, the more efficient the investment or portfolio. The Nitrogen GPA ranges from 1.0 to 4.3. Generally speaking, a GPA above 3.5 reflects an efficient investment.

What does Nitrogen GPA do?

Nitrogen GPA is a risk-adjusted return metric, which, like other risk adjusted return metrics, utilizes returns, volatility (in the form of standard deviation), and a risk-free rate to derive its output. Unlike other risk-adjusted return metrics, Nitrogen GPA was designed to address three core problems with traditional risk-adjusted return metrics; 1) help differentiate return efficiency among investments or portfolios with similar risk profiles (via the Risk Number), 2) simplify the advisor-client conversation about investment return efficiency, and 3) power additional analysis as an input.

What are the best practices for using Nitrogen GPA?

In a Client Meeting

Nitrogen GPA is a visually powerful method to prove you are selecting a top-performing portfolio to put a client's capital to work. The conversation surrounding risk is already well covered in the Risk Number®, but Nitrogen GPA provides a seamless transition to how efficient the risk taken is at producing rewards.

This is ultimately what Nitrogen GPA encourages; not just risk alignment, but how to efficiently use that risk to create rewards for investor portfolios.

Investment Selection

When selecting investments for use in a portfolio, advisors depend on a score of factors in making that determination (sector, standard deviation, beta, etc.). With GPA, we establish a new mindset of risk-adjusted return analysis as a method by which advisors can find comfort in their objective investment selection process. Traditional risk-adjusted return metrics are often time dependent ("ex post"), which is to say that they apply only to a specific historical period of time, such as a trailing 1Y, 3Y, 5Y, and so forth.

In selecting an analysis epoch which covers multiple market environments (for example 2008 to present), Nitrogen moves away from arbitrary periodicity tables and into a "living" risk-adjusted return metric. As a "living" value, Nitrogen GPA provides advisors with an opportunity to understand the efficiency, per unit of risk, for individual investments and portfolios through the lens of a full market cycle. This stands in stark contrast with traditional "ex post" analyses which are only relevant for the specific time frame in which they are assessed.



¹ Sharpe, William F. (1994). "The Sharpe Ratio". *The Journal of Portfolio Management*. 21 (1): 49–58.

EMLP · First Trust North Amer Engy InfracETF

Price as of Nov 22, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$24.74	3.95%	0.95%	6.68%

Summary [ETF](#)

RISKALYZE GPA **3.6**

MLPI · UBS E-TRACS Alerian MLP Infrastructure ETN

Price as of Nov 25, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$18.39	8.44%	0.85%	2.44%

Summary [ETF](#)

RISKALYZE GPA **2.9**

Energy

The Nitrogen GPA makes comparing similar investment ideas easy. Here's an example comparison of two Energy Infrastructure investments side by side.

RISK
33

PFMIX · PIMCO Municipal Bond Instl

Price as of Dec 13, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$10.13	3.28%	0.55%	3.95%

Security Summary [FUND](#)

RISKALYZE GPA **3.9**

Municipal Bonds

Here's an example comparison of two municipal investments, side by side. Again the Nitrogen GPA makes it easy to see which fund is more efficient.

RISK
47

PIMAX · Pioneer High Income Municipal A

Price as of Dec 12, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$7.49	4.78%	0.83%	3.67%

Security Summary [FUND](#)

RISKALYZE GPA **3.4**

RISK
87

FIDU · Fidelity® MSCI Industrials ETF

Price as of Dec 13, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$42.10	1.69%	0.08%	7.45%

Security Summary [ETF](#)

RISKALYZE GPA **3.5**

Industrials

Here is a comparison of similar investments.

RISK
86

EXI · iShares Global Industrials

Price as of Dec 13, 2019	Annual Dividend	Expense Ratio	Potential Annual Return
\$97.98	1.75%	0.46%	6.81%

Security Summary [ETF](#)

RISKALYZE GPA **3.4**

With just a glance, the Nitrogen GPA makes comparing investments across different sectors intuitive and easy.

Next, you can see a sample of individual stocks from various sectors. Notice how easy it is to spot the high GPAs.

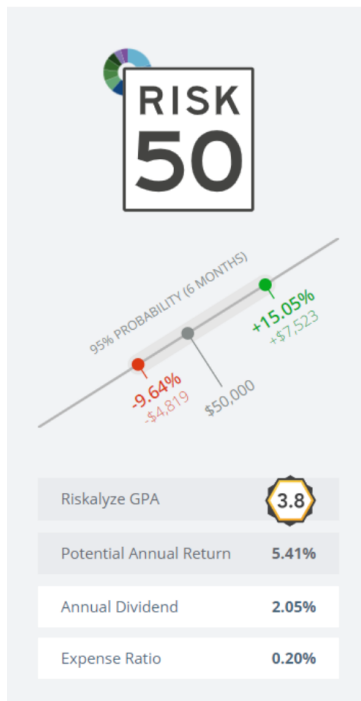
Stock	RISK	Price as of	Annual Dividend	Expense Ratio	Potential Annual Return	RISKALYZE GPA
FDX · FedEx Corporation	93	Dec 13, 2019 \$165.67	1.57%	—	6.05%	3.2
GE · General Electric Company	97	Dec 13, 2019 \$11.34	0.35%	—	-2.99%	1.0
CVX · Chevron Corporation	86	Dec 16, 2019 \$119.36	3.99%	—	9.94%	3.8
FB · Facebook Inc.	99	Dec 13, 2019 \$194.11	0.00%	—	14.13%	3.4
PFE · Pfizer Inc.	87	Dec 16, 2019 \$39.14	3.68%	—	4.61%	3.2
AAPL · Apple Inc.	91	Dec 16, 2019 \$279.86	1.09%	—	19.09%	4.2

Portfolio Comparisons

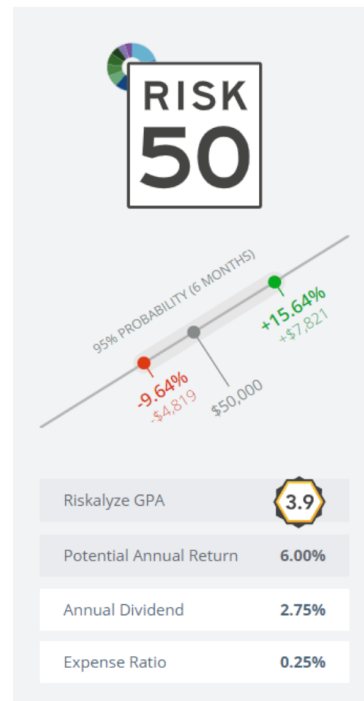
Housed in the language of academic performance, Nitrogen GPA levels the playing field by removing much of the technical language around explaining risk-adjusted return efficiency. One of the most common use cases of GPA in a client meeting is to show how two similar Risk Number portfolios may differ with respect to their return efficiency. Without the nuance offered by Nitrogen GPA, how would an advisor differentiate best interest for a client portfolio if their current allocations already meet their risk appetite?

Take, for example, the two following Risk Number 50 portfolios:

EXAMPLE 1



EXAMPLE 2



The story about which portfolio is “more efficient” or “better” becomes intuitive with GPA.

In Example 2, the GPA is 0.1 point higher, the Potential Annual Return is 59 bps higher, and the annual dividend is 70 bps higher for the cost of an additional 5 bps of expenses. The risk level is the same (both are a Risk Number 50), which allows the advisor to pivot the conversation towards efficiency. The question is now no longer “What is my Risk Number?” but is now “Of these similar Risk Number portfolios, which one is best?”

Model Building

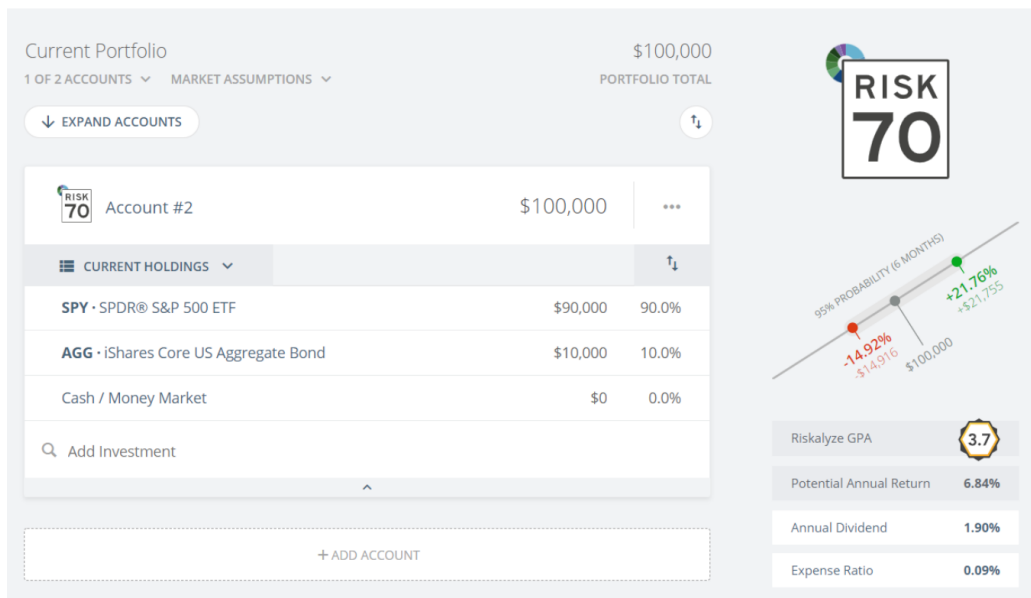
Comparing models based on the Nitrogen GPA can be as simple as our example of comparing individual investments, or it can provide additional insights due to our use of a covariance matrix which shows the impacts of hedging across multiple holdings.

Nitrogen GPA enhances the model building process not only by differentiating similar Risk Number portfolios by

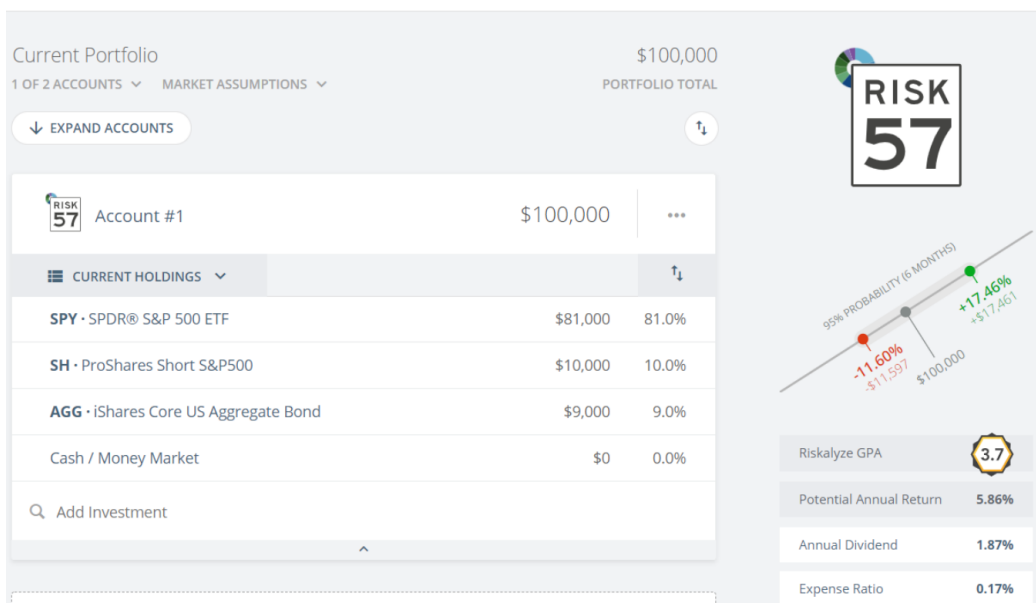


efficiency, but also by providing interesting opportunities to select investments which may, unintuitively, have low GPAs, but contribute to the overall portfolio efficiency.

Consider the case of a 90/10 equity/bond portfolio as follows:

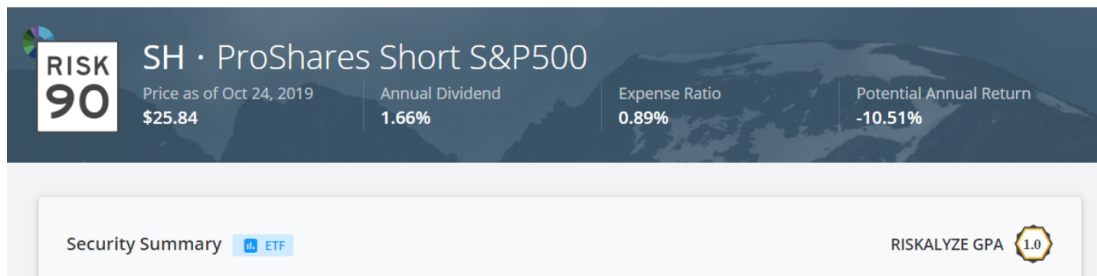


Here we see that the portfolio receives a GPA of 3.7, but with a Risk Number of 70. By introducing a 10% short position on the equity section as follows:



We end up maintaining our efficiency at a GPA of 3.7, but have reduced our Risk Number to 57. What makes this mild change so significant is that our short position has a Nitrogen GPA of 1.0 due to its overall negative return trend of the measured historical timeframe.





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How is GPA calculated?

At its core, Nitrogen GPA is the risk-free rate subtracted from expected returns divided by standard deviation, which can be expressed as follows:

$$\text{Nitrogen GPA} = [(\text{Expected Return} - \text{Risk-free Rate}) / \text{Standard Deviation}]$$

However, Nitrogen GPA applies a proprietary conversion factor to this ratio in order to derive an output between 1.0 and 4.3.

How are these inputs defined?

Nitrogen uses expected return, a risk-free rate, and standard deviation to calculate the Nitrogen GPA. These inputs are further defined as follows:

- **Expected Return** - The return expectation of a given security is its compound annual growth rate (CAGR) of net historical performance (net of distributions, fees, splits, capital gains, etc.) segmented from an annual value and into a 6-month value. It is expressed as follows:

$$\text{6-month expected return} = [(1 + \text{CAGR})^{0.5} - 1]$$

- **Risk-free Rate** - Calculated as the average yield of six month constant maturity treasury yield histories starting June 2004 to present. Nitrogen reviews this value bi-annually and adjusts it if there is a delta greater than or equal to 4 bps.
- **Standard Deviation** - The standard deviation of a given security is generally its variance of monthly performance values multiplied by the square root of six. It is expressed as follows:

$$\text{6-month standard deviation} = [\text{stdev}(\text{monthly performance values}) \times \text{sqrt}(6)]$$

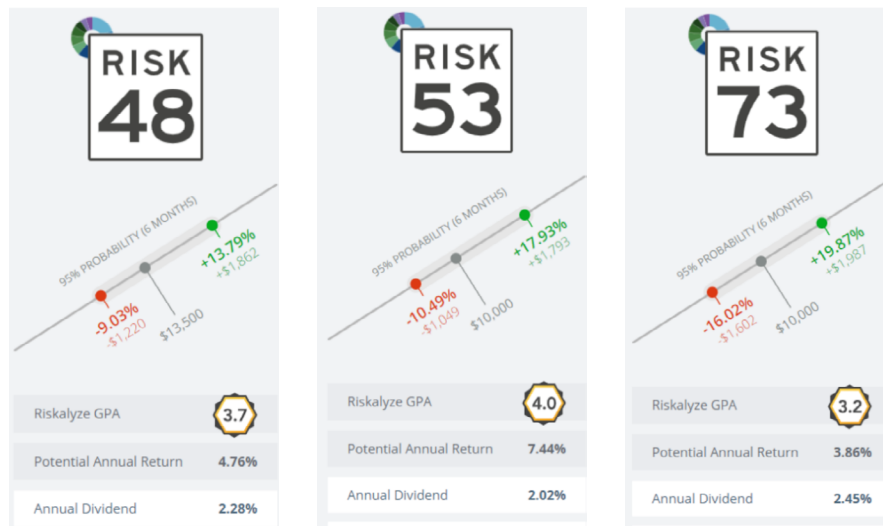
What is the Nitrogen GPA range?

The Nitrogen GPA ranges from 1.0 (lowest score) to 4.3 (highest score). Generally speaking, a GPA above 3.5 is seen as "efficient." As a benchmark, as of November 26, 2019 the Standard and Poor's index scores a Nitrogen GPA of 3.7.



The Nitrogen GPA and the Risk Number

The Nitrogen Risk Number is a risk-centric metric that intuitively highlights the downside risk associated with an investment, strategy, model, or portfolio. It may be of interest to understand the relationship between the Risk Number and GPA.



There are two significant points made by comparing the analysis of these three portfolios.

1. Increasing the Risk Number does not necessitate nor guarantee that the Nitrogen GPA increases. In fact, it may be more difficult to meaningfully increase the Risk Number while adding return efficiency.
2. Similarly, lowering the Risk Number does not necessitate nor guarantee that the Nitrogen GPA increases. It is entirely possible to harm the return efficiency of a portfolio by lowering its Risk Number.

Not all portfolios are created equal; risk taken is not equivalent in any capacity to return efficiency. As such, The Risk Number itself does not inform the Nitrogen GPA. Instead, the Nitrogen GPA is informed by the return and variance of the composition of the underliers which create a given portfolio.

What enhancements does the Nitrogen GPA have compared to other risk-adjusted return metrics, specifically Sharpe Ratio?

In designing Nitrogen GPA, there are several distinct properties and assumptions made by Sharpe Ratio that Nitrogen GPA addresses that are outlined below.

- **Use of geometric mean vs arithmetic mean² (no discrete values)**
Rather than an arithmetic average of discrete time periods, Nitrogen GPA utilizes the security or portfolio geometric mean in order to consider the effects of compounding returns. Further, because a geometric mean is used for the determination of a portfolio-wide GPA, the effects of correlations among underliers is built in.
- **Use of a stable, historically specific risk-free rate vs a volatile one based on some current T-bill rate**
Nitrogen GPA uses an average yield of six month constant maturity treasury yield histories to create a risk-free rate. This value creates long-term stability in the calculation of GPA as it would require a serial substantial shift in direction and magnitude of the treasury yields to significantly alter the value. This stands in stark contrast of attempts to define a “riskless security” as being equivalent with some Treasury Bill rate and instead creates a value with hyper-specificity and low variability. This is all achieved using the actual Constant Maturity Treasury rates posted by the United States Treasury. This information can be found here: [U.S. Treasury - CMT Rates](#)

² Levy, Moshe. (2017). “Measuring Portfolio Performance: Share, Alpha, or the Geometric Mean?” Journal of Investment Management. 15 (3): 1-17

- **Correct scaling when expected returns are negative³**

With a negative ratio, as the denominator (risk) increases in magnitude the ratio will approach zero assuming the numerator (reward) stays constant. Traditional risk-adjusted return metrics incorrectly display this behavior as increasing return efficiency.

In the following scenario, an increasing denominator incorrectly exponentially pushes the ratio towards zero.

	EXCESS RETURN (REWARD)	VOLATILITY (RISK)	RATIO
Example 1	-1.00%	1.00%	-1.00
Example 2	-1.00%	2.00%	-0.50
Example 3	-1.00%	3.00%	-0.33
Example 4	-1.00%	4.00%	-0.25
Example 5	-1.00%	5.00%	-0.20
Example 6	-1.00%	6.00%	-0.17
Example 7	-1.00%	7.00%	-0.14
Example 8	-1.00%	8.00%	-0.13
Example 9	-1.00%	9.00%	-0.11
Example 10	-1.00%	10.00%	-0.10

In the above example, excess return is a constant negative value. As the risk portion of the ratio increases, moving up from 1% volatility to 10% volatility, the ratios become more positive and approach zero. This chart would incorrectly posit that Example 10 has the best ratio as it has the most positive ratio, or closest to zero. In reality, Example 10 is the worst by virtue of having the highest volatility. The expectation is that Example 10 should have the worst risk-adjusted return ratio by “punishing” the increase in volatility as the numerator remains constant. Instead, the increase in volatility “rewards” the output for increasing the magnitude of the denominator without any change to the numerator. Nitrogen GPA corrects this problem to ensure continuity of the ratio logic where return is a linear function of the ratio and volatility is an exponential function of the ratio.

- **Not utilizing outdated asset allocation mapping, back-tested⁴, or benchmark data**

A core value at Nitrogen is objectivity. We do not assume that any given investment will perform similarly to any benchmark, asset allocation mapping, or index, and therefore do not use that data in calculating Nitrogen GPA. Instead, Nitrogen calculates our risk-centric statistics from actual price/return history for every publicly traded investment in our platform. When calculating the Nitrogen GPA for portfolio, models, or strategy, the Nitrogen GPA is weighted using the allocation of the underliers.

Nitrogen does incorporate [Extrapolation Methodology](#) to better assess the risk of securities which have not experienced a bull market. At its core, Extrapolation is a mathematically consistent and robust method of identifying a statistically significant similar security or index which creates a ratio that is then multiplied by the young securities actual historical volatility.

- **“Living” forward-projected ratio (“ex-ante”)**

A core value proposition of Nitrogen is in helping the financial advisor set strong expectations of portfolio risk taken by an investor. Nitrogen GPA will invariably adjust over time with an accumulating pool of performance values of the portfolio underliers. The end result is a “living” risk-adjusted return metric which adapts to market performance.

- **Intuitive Scaling rather confusing asset-class specific metrics**

Many commonplace metrics (Sharpe, Trenor, Sortino) require the user to first have a foundation of understanding that is sector or asset class specific. Where other ratios require knowledge of what ratio is strong or weak based on the investment’s sector or asset class, Nitrogen GPA employs intuitive scaling that removes the need for intimate knowledge of each sector or asset class.

³ Israelsen, Craig L. (2003). “Sharpening the Sharpe Ratio.” *Financial Planning*, 33 (1), 49-51. Israelsen, Craig L. (2005). “A refinement to the Sharpe Ratio and Information Ratio.” *Journal of Asset Management*, 5, 423-427

⁴ Bailey, David H. and Borwein, Jonathan and López de Prado, Marcos and Zhu, Qiji Jim, (May 2014). “Pseudo-Mathematics and Financial Charlatanism: The Effects of Backtest Overfitting on Out-of-Sample Performance.” *Notices of the American Mathematical Society*, 61(5), 458-471.



For example, to answer “What’s a good Sharpe Ratio?” one must account for the sector or asset class in question. Comparing Sharpe Ratios across sectors or asset classes is not intuitive.

Nitrogen GPA is scaled in a manner that makes comparing investments across sectors or asset classes much more intuitive, as the scale has been normalized. For example, notice how the Nitrogen GPA scaling has utility across sectors and asset classes while other ratios do not.

Risk Model

The Nitrogen GPA is impacted by the specific risk model selected by the advisor. Advisors may choose to use historical average returns or Nitrogen’s Advanced Risk Modeling (ARM). Advanced Risk Modeling empowers advisors to incorporate capital market assumptions into the analysis. When ARM is enabled as the advisor’s default, the Nitrogen GPAs shown will incorporate the advisor’s capital market assumptions. Advisors may also choose to use the average return risk model as the default setting, while incorporating capital market assumptions at the portfolio level for specific clients. The default risk model, as selected in settings (shown below) will drive the calculated GPA throughout Nitrogen. For more information about Nitrogen’s Advanced Risk Modeling (ARM) please see our [knowledge base](#).

Advanced Risk Modeling

SET DEFAULT MARKET ASSUMPTIONS

Average Return ▾

Average Return Use average annual return for all securities.		
Market Scenarios (Six Month Average)	S&P 500 Index	10 YR Treasury
Last 10 Years	+4.37%	-11.8bps
Last 30 Years	+5.77%	-8.26bps
Interest Rates +1%	+3.75%	100bps

The Risk Numbers and GPAs used in this report are calculated using Nitrogen’s average return risk model unless otherwise noted. This report is for educational purposes only.

READY TO JOIN THE FEARLESS INVESTING MOVEMENT?

We’d love to show you how 20,000 advisors are empowering fearless investing with the Risk Number.

Take a Personal Tour

About Nitrogen

Nitrogen revolutionized how financial advisors and wealth management firms grow with the launch of Riskalyze in 2011. Today, Nitrogen is the growth platform for wealth management firms, helping advisors turn leads into meetings, meetings into valued clients, and clients into referral champions. The company invented the Risk Number®, built on top of a Nobel Prize-winning academic framework, and is the champion of the Fearless Investing Movement — tens of thousands of financial advisors committed to our mission of empowering the world to invest fearlessly. To learn more, visit NitrogenWealth.com.