# ARQuant's Edge: Boosting Market Beta Portfolios Through Superior Risk-Adjusted Returns

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### Summary

We are pleased to present our first white paper, titled "ARQuant's Edge: Boosting Market Beta Portfolios Through Superior Risk-Adjusted Returns." This paper explores how ARQuant's algorithmic trading strategy can achieve superior risk-adjusted returns, particularly when combined with traditional market portfolios such as the S&P 500. By systematically optimizing Sharpe and Sortino ratios across various estimation methods and time periods, we found that allocating 30% and 70% of a portfolio to the ARQuant strategy can significantly enhance the performance of a market beta core. These blended portfolios consistently outperform popular ETFs (e.g., SPY, QQQ, etc.) in key metrics such as volatility, drawdown, and return efficiency.

# Why Risk-Adjusted Returns?

Risk-adjusted returns evaluate the returns of an investment relative to the risk undertaken to achieve those returns. Simply put, they provide a way to compare investments by taking into account both profit (returns) and uncertainty (risk), addressing the question, "Is the reward worth the risk?"



Below are key ways to measure risk-adjusted returns used in our study:

- Sharpe Ratio: Determines whether an investment's returns justify its volatility. Formula: (Annual Return – Risk-Free Rate) ÷ Volatility.
- Sortino Ratio: Focuses on an investment's downside risk, emphasizing how often losses occur and their magnitude. It is similar to the Sharpe Ratio but better tailored to assessing negative risks.
- **Calmar Ratio**: Evaluates returns relative to maximum drawdowns. It measures the efficiency of returns during periods of extreme declines in value.

A higher ratio in any of these metrics indicates higher returns for the associated risk.

## **ARQuant's Stand-Alone Performance**

ARQuant Management obtained FCA authorization in March 2022 and began managing segregated accounts in April 2022. From inception to March 2025, the ARQuant strategy delivered an annualized return of 10.11%, closely matching SPY's 10.09% and rivalling growth-focused ETFs such as QQQ (11.64%) and IWF (11.54%).

Where ARQuant excels is in managing risk. It boasts the lowest annualized volatility (9.35%) among these ETFs and a maximum drawdown (MaxDD) of just 6.23%, compared to SPY's 20.25% and QQQ's 26.1%.

This efficiency translates into a superior Sharpe Ratio of 0.62, significantly outpacing SPY (0.33), QQQ (0.33), IWF (0.35), and MTUM (0.26). Similarly, ARQuant's Sortino Ratio (3.53) and Calmar Ratio (4.87), which emphasize downside risk and drawdowns respectively, outperform all ETFs, including SPY (1.45 and 1.5) and QQQ (1.39 and 1.34).

Additionally, 58% of ARQuant's months have been positive, which aligns with QQQ and IWF, and only slightly trails SPY (61%). However, ARQuant's superior risk-adjusted metrics highlight its consistency and reliability.

Note:

- 1. These ratios were calculated using the TB3MS (3-month Treasury Bill) as the risk-free rate.
- 2. See the metric table on page 5



# **ARQuant's Uniqueness: Low market correlation**

The ARQuant strategy demonstrates a remarkably low market correlation with major ETFs, underscoring its distinctiveness in the investment landscape. Analysis of monthly returns reveals a mean 12-month rolling correlation of just 0.11 with SPY (std dev: 0.16), 0.15 with QQQ (std dev: 0.13), and 0.10 with MTUM (std dev: 0.27).



These consistently low correlations, coupled with moderate variability, indicate that ARQuant's returns are largely independent of broad market trends, positioning it as a unique approach that offers significant diversification benefits to investors seeking to reduce exposure to conventional market movements.

## **Blending ARQuant with Market Beta: Portfolio Construction and Optimization**

Combining ARQuant with traditional market beta yields impressive results. Two portfolios were constructed using 70% SPY + 30% ARQuant and 30% SPY + 70% ARQuant. These allocations, determined via rigorous optimization, were selected to maximize Sharpe or Sortino ratio across three data periods (36, 24, and 12 months) and various estimation methods for expected returns and volatility (e.g., geometric mean, EWMA, Ledoit-Wolf shrinkage), totalling 162 variants.

As show below, the results were consistent either for Sharpe or Sortino ratio.





#### Performance of the constructed portfolios:

- 1. 70% SPY + 30% ARQuant:
  - Annualized Return: 10.1%.
  - Max Drawdown: 12.03% (nearly half of SPY's).
  - **Positive Months**: 64%, outperforming all ETFs (SPY at 61%).
  - Reflects improved reliability and reduced risk.
  - 30% weight of ARQuant is the minimum
- 2. **30% SPY + 70% ARQuant**:
  - Annualized Return: 10.1%.
  - Volatility: Lowest among alternatives at 8.51%.
  - **Max Drawdown**: Just 4.45%, significantly lower than SPY (20.25%) and QQQ (26.1%).
  - **Positive Months**: 58%, matching QQQ.
  - Displays exceptional downside protection and the highest risk-adjusted performance
  - 70% weight of ARQuant is the middle of confidence interval.

Both portfolios outperform popular ETFs in risk-adjusted metrics. Visualization of the portfolios placed them in the optimal range above and to the right of the ETFs, with 30% SPY + 70% ARQuant emerging as the Paretooptimal blend. This highlights how the ARQuant strategy reduces risk and enhances returns compared to traditional ETFs.



From 2022-04



# What Can Metrics Tell?

The table below presents seven metrics calculated for ARQuant, the constructed portfolios, and the ETFs using their monthly returns.

Risk-Return	Ann. Return	Ann.	MaxDD	Positive	Sharpe	Sortino	Calmar
Metrics	(%)	Volatility	(%)	Months (%)			
		(%)					
ARQuant	10.1	9.4	6.2	58	0.62	3.53	4.87
SPY	10.1	17.3	20.3	61	0.33	1.45	1.5
QQQ	11.6	21.9	26.1	58	0.33	1.39	1.34
IWF	11.5	20.5	23.9	58	0.35	1.47	1.45
IWD	7.7	17.0	17.2	56	0.2	1.15	1.34
IWN	2.6	24.0	19.3	42	-0.07	0.17	0.4
IWO	3.5	23.9	19.3	44	-0.03	0.3	0.55
MTUM	9.3	19.0	21.2	53	0.26	1.36	1.31
70%SPY +	10.1	12.6	12.0	64	0.46	2.06	2.52
30%ARQuant							
30%SPY +	10.1	8.5	4.5	58	0.68	4.16	6.8
70%ARQuant							

Note: Risk-free rates are 4.34% (Y2022), 4.17% (Y2023), 4.97% (Y2024), 4.71% (Y2025)

#### **Insights:**

- 70% SPY + 30% ARQuant offers balanced exposure and moderate drawdown protection.
- **30% SPY + 70% ARQuant** achieves maximum risk-adjusted returns, highlighted by its deep positioning in high-efficiency, low-risk space.
- **ARQuant** strategically reduces risk while delivering robust performance, enhancing portfolio efficiency.

### What is Inside the Box?

At first glance, ARQuant's daily performance may resemble a coin toss, with nearly equal numbers of profitable and losing days.

However, this initial impression is misleading - its average daily profit exceeds its daily losses, resulting in positive average monthly returns. See plots on the next page.

This asymmetry strengthens over longer holding periods. The optimal investment period is at least 3 years.





Using weekly data from March 2018 to March 2025 (371 weeks), K-means clustering revealed three distinct patterns based on the relationship between ARQuant returns and VIX volatility, as shown below.

Cluster	Weeks	ARQuant Return	VIX Weekly Average	VIX Weekly HL
0	12	2.42%	41.5	13.9
1	250	0.06%	16.6	1.9
2	109	1.56%	25.1	4.6

#### • Cluster 0 (High Volatility, blue dots on the plot below):

- Weekly Returns: 2.42% on average.
- VIX Average: 41.5.
- Rare extreme weeks (12 total) with high profitability.
- $\circ~~8$  weeks with an average profit of 4.61% and 4 weeks with average loss of -1.97%

#### • Cluster 1 (Low Volatility, grey):

- Weekly Returns: Slightly positive 0.06%.
- VIX Average: 16.6.
- Accounts for 250 weeks, preserving capital during low-volatility periods.
- $\circ~124$  weeks with an average profit of 1.43% and 126 weeks with average loss of -1.28%



- Cluster 2 (Moderate Volatility, orange):
  - Weekly Returns: 1.56%.
  - VIX Average: 25.1.
  - Includes 109 weeks, with winning weeks vastly outnumbering losing weeks.
  - 83 weeks with average profit of 2.33% and 26 weeks with average loss of -0.91%

# ARQuant thrives during volatility-driven market conditions (VIX > 20) and carefully preserves client capital during quieter periods.



# Key Takeaways: ARQuant's Advantage

ARQuant's strategy redefines success through superior risk-adjusted performance rather than raw return outperformance:

- 70% SPY + 30% ARQuant offers market-like returns with reduced volatility and drawdowns, ideal for index fund investors.
- **30% SPY + 70% ARQuant** prioritizes efficiency, offering the highest Sharpe, Sortino, and Calmar ratios, making it perfect for sophisticated investors seeking optimized risk-reward outcomes.

Both portfolios surpass popular index ETFs in risk-adjusted metrics and downside protection. Principal Component Analysis and K-means clustering confirm ARQuant's unique positioning in the investment landscape, thriving in volatile conditions and elevating portfolio resilience.



# Disclaimer

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