

A photograph of a modern concrete staircase with a metal handrail. A white line graph is superimposed on the steps, starting at the bottom left and rising towards the top right, symbolizing growth or progress.

The Risky Business of Safe Investing Optimizing Conservative Portfolios

FA24-AAI-500 FINAL PROJECT

PRESENTED BY CARRIE LITTLE AND IAN LUCAS



Agenda



- **Introduction**
- **Data Overview**
- **Data Analysis**
- **Portfolio Strategies**
- **Key Findings**
- **Recommendations**
- **Conclusion**
- **Next Steps**



Introduction

- **Background**

Significant client losses in 2022 prompted a shift to safer Treasury Bills. With rate cuts now likely, clients are looking for alternative strategies that return over 4% with reduced risk.

- **Goal**

Explore new investment strategies using liquid funds, comparing Risk Parity, Minimum Variance, and Maximum Diversification approaches to provide enhanced returns while managing risks.



Data Overview

- **Dataset**

Monthly returns from 15 ETFs and mutual funds from November 2014 to August 2024.

Assets - Vanguard LifeStrategy (benchmark), Bitcoin, Treasury ETFs, Gold, VIX, commodities, market neutral, long-short equity, etc.

- **Sources**

From Portfolio Visualizer; standardized with no missing values.

<https://www.portfoliovisualizer.com/backtest-portfolio?s=y&sl=5M8RhWX2CyedGtfIDJRlyP>

https://github.com/littlecl42/AAA500_FinalProject_CL_IL



Individual Assets

	Count
Vanguard LifeStrategy Income Fund (VASIX)	118
Vanguard Total World Stock ETF (VT)	118
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	118
AQR Diversified Arbitrage I (ADAIX)	118
iShares Gold Trust (IAU)	118
Bitcoin Market Price USD (^BTC)	118
AQR Risk-Balanced Commodities Strategy I (ARCIIX)	118
AQR Long-Short Equity I (QLEIX)	118
AQR Style Premia Alternative I (QSPIX)	118
AQR Equity Market Neutral I (QMNXIX)	118
AQR Macro Opportunities I (QGMIX)	118
AGF U.S. Market Neutral Anti-Beta (BTAL)	118
AQR Managed Futures Strategy HV I (QMHIX)	118
ProShares VIX Mid-Term Futures (VIXM)	118
Invesco DB US Dollar Bullish (UUP)	118



Data Analysis

- **Risk and Return Characteristics**

Benchmark: Growth Rate 3.4%; Volatility 5.6%; Max Drawdown 16.7%

Growth Rates: 8 Assets > 5%; 4 Assets 0-5%; 2 Assets < 0%

Volatility: 4 Assets < 10%; 8 Assets 10-20%; 3 Assets > 20%

Max Drawdown: 3 > -15%; 3 Assets -15 to -30%; 8 Assets



Asset Performance Summary

Risk and Return Characteristics for All Assets

	Asset	CAGR (%)	Annualized Std Dev (%)	Best Year (%)	Worst Year (%)	Max Drawdown (%)
0	Vanguard LifeStrategy Income Fund (VASIX)	3.35	5.63	12.05	-13.93	-16.72
1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82
6	AQR Risk-Balanced Commodities Strategy I (ARCIIX)	5.40	16.25	39.60	-19.50	-30.09
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58
9	AQR Equity Market Neutral I (QMNXIX)	6.08	9.95	27.21	-19.52	-38.28
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41
12	AQR Managed Futures Strategy HV I (QMHIX)	2.99	16.43	49.99	-14.44	-36.26
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79



Data Analysis

- **Correlation Matrix Heatmap (Lower Triangle)**
 - Visually represents how each asset in the portfolio correlates with the others
 - Helps identify opportunities for diversification
 - Optimize the asset mix to minimize risks
- **12 Month Rolling Cross Correlations**
 - Fluctuations in correlation
 - Outlier Analysis
- **Correlation Summary Table**
 - Compares VASIX and other assets
 - Summary of Average Positive And Negative Correlations



Correlation Matrix Heatmap (Lower Triangle)

Correlation Insights
Numerous assets have **negative cross-correlations**, indicating diversification potential.

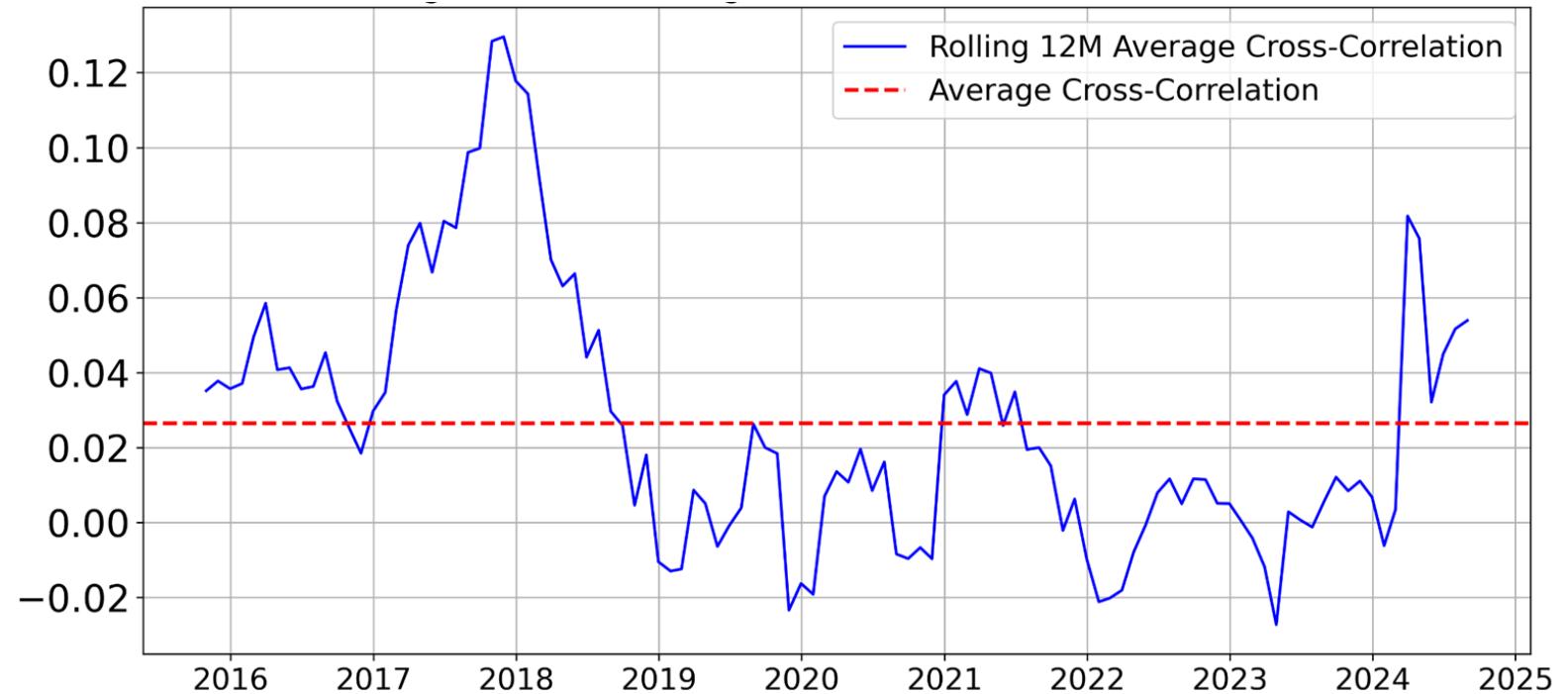
Vanguard LifeStrategy Income Fund (VASIX)	VT	ZROZ	ADAIX	IAU	\wedge BTC	ARCIX	QLEIX	QSPIX	QMNX	QGMIX	BTAL	QMHIX	VIXM	UUP
Vanguard Total World Stock ETF (VT)	0.80													
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	0.62	0.11												
AQR Diversified Arbitrage I (ADAIX)	0.39	0.51	-0.01											
iShares Gold Trust (IAU)	0.37	0.14	0.42	0.04										
Bitcoin Market Price USD (\wedge BTC)	0.29	0.32	0.08	0.28	0.09									
AQR Risk-Balanced Commodities Strategy I (ARCIX)	0.25	0.48	-0.15	0.44	0.38	0.17								
AQR Long-Short Equity I (QLEIX)	0.22	0.46	-0.20	0.09	0.03	0.10	0.36							
AQR Style Premia Alternative I (QSPIX)	-0.16	0.01	-0.29	-0.10	-0.15	-0.04	0.14	0.73						
AQR Equity Market Neutral I (QMNX)	-0.23	-0.14	-0.24	-0.23	-0.01	-0.12	0.09	0.80	0.81					
AQR Macro Opportunities I (QGMIX)	-0.35	-0.08	-0.32	0.12	-0.16	-0.06	0.11	0.07	0.22	0.10				
AGF U.S. Market Neutral Anti-Beta (BTAL)	-0.40	-0.64	0.12	-0.49	0.17	-0.22	-0.32	-0.18	0.16	0.23	-0.07			
AQR Managed Futures Strategy HV I (QMHIX)	-0.43	-0.34	-0.11	-0.21	0.06	-0.05	-0.04	0.03	0.19	0.25	0.56	0.34		
ProShares VIX Mid-Term Futures (VIXM)	-0.49	-0.72	0.06	-0.35	0.10	-0.22	-0.34	-0.50	-0.16	-0.08	-0.03	0.48	0.25	
Invesco DB US Dollar Bullish (UUP)	-0.51	-0.50	-0.23	-0.27	-0.46	-0.15	-0.47	-0.15	0.09	0.13	0.23	0.29	0.35	0.21

Correlation Insights

Vanguard Total World Stock (VT) **correlates highest** with Vanguard LifeStrategy (VASIX) at **0.80**



Rolling Correlations & Outlier Analysis



	VASIX Return (%)	VT	ZROZ	ADAIX	IAU	^BTC	ARCIX	QLEIX	QSPIX	QMNX	QGMIX	BTAL	QMHIX	UUP	VIXM
Average Positive	3.88	8.54	8.21	2.07	2.45	20.40	2.51	1.95	-1.47	-1.29	0.09	-6.93	-4.85	-1.57	-8.92
Average Negative	-3.21	-6.69	-6.28	-1.42	-2.04	-13.94	-2.63	-0.12	3.01	2.49	3.29	4.79	7.03	2.72	9.84
Correlation	1.00	0.94	0.80	0.61	0.56	0.68	0.48	0.30	-0.32	-0.34	-0.64	-0.80	-0.95	-0.86	-0.59



Portfolio Optimization Strategies

- **Risk Parity**

Balances risk across all assets, resulting in lower concentration and a balanced risk profile.

- **Minimum Variance**

Prioritizes reducing risk in the form of standard deviation, often excluding higher-risk assets and leading to concentration in lower-risk instruments.

- **Maximum Diversification**

Aims to maximize portfolio diversification, including assets with low correlation to reduce risk.



Key Findings

Optimal Strategy

Risk Parity offers the best balance between risk and return.

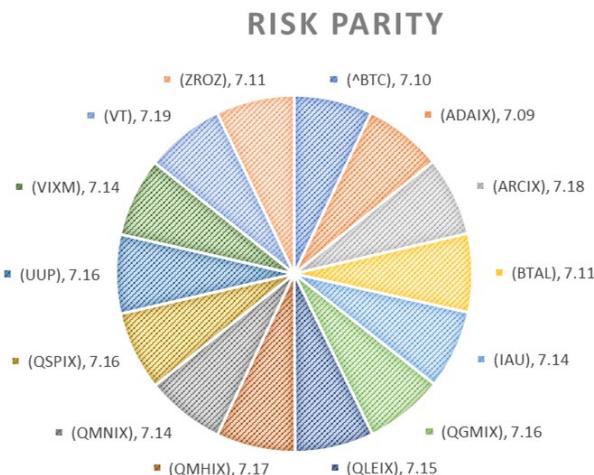
Performance

Risk Parity shows the highest Compound Annual Growth Rate (CAGR) (5.38%) among the models with a modest maximum drawdown (-2.87%) without excluding any assets (doesn't "play favorites")

Performance Metrics Table:

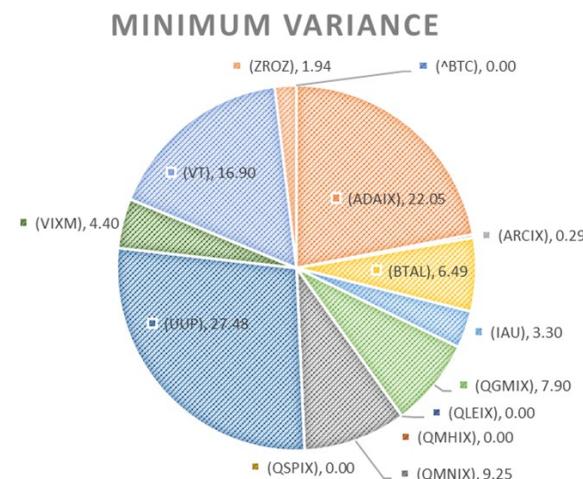
	Risk Parity	Minimum Variance	Maximum Diversification	VASIX (Benchmark)
CAGR (%)	5.38	4.66	4.71	3.38
Standard Deviation (%)	2.93	2.35	2.61	5.63
Maximum Drawdown (%)	-2.87	-2.21	-2.77	-16.72

Model Analysis



Risk Parity:

Balances risk across all assets, resulting in lower concentration and a balanced risk profile.



Minimum Variance Excludes:

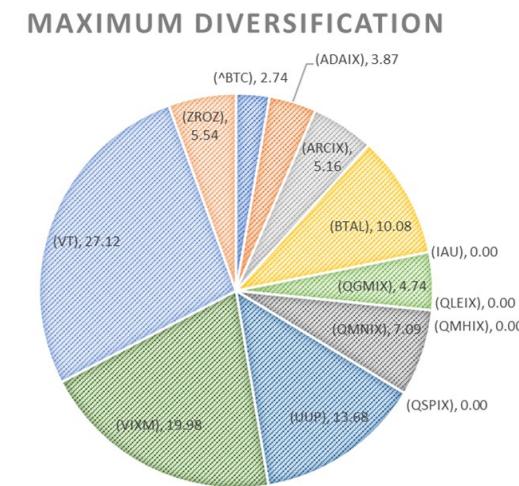
- Bitcoin Market Price USD (ABTC)
- AQR Long-Short Equity I (QLEIX)
- AQR Style Premia Alternative I (QSPIX)
- AQR Managed Futures Strategy HV I (QMHIX)

Limitations

Minimum Variance and Maximum Diversification portfolios exclude too many assets

Maximum Diversification excludes:

- iShares Gold Trust (IAU)
- AQR Long-Short Equity I (QLEIX)
- AQR Style Premia Alternative I (QSPIX)
- AQR Managed Futures Strategy HV I (QMHIX)



(^BTC)
(ADAIX)
(ARCIX)
(BTAL)
(IAU)
(QGMIX)
(QLEIX)
(QMHIX)
(QMHNIX)
(QSPIX)
(UUP)
(VIXM)
(VT)
(ZROZ)



Recommendations

- **Risk Management**

Focus on Risk Parity for balanced risk exposure, while Maximum Diversification can enhance potential returns.

- **Extend Data Collection**

More historical and macroeconomic data would provide robustness to capture different market cycles.

- **Machine Learning Techniques**

Consider clustering assets based on risk-return characteristics for a streamlined portfolio.



Conclusion

- **Balanced Approach**

Using Risk Parity with a mix of high and low-risk assets provides robust returns with controlled volatility.

- **Client Alignment**

The recommended portfolio strategy aligns with client goals for moderate risk and returns exceeding 4%.



Next Steps

- Implement the proposed Risk Parity allocation strategy.
- Broaden the dataset and leverage advanced statistical models for better predictions.
- Regularly review asset performance, especially under changing market conditions, to ensure ongoing alignment with client goals.



Division of Labor

Week 3	Form Teams, Choose Project/Dataset In-Person Meeting, Create Collab Files/Folder Formulate Research Questions Generate Business Objective Review Dataset, Generate Data Descriptives	Ian/Carrie Ian/Carrie Ian Carrie Carrie
Week 4	Outline Data Analysis Plan Develop Preliminary Models In-Person Meeting, Analyze Models Develop Conclusions and Recommendations Submit Final Project Check-in	Ian Ian/Carrie Ian/Carrie Ian/Carrie Ian
Week 5	Draft Report Draft Presentation	Ian Carrie
Week 6	In-Person Meeting, Review Drafts Review Tables/Figures/Visualizations Review References/Sources/Links In-Person Meeting - Presentation Review	Ian/Carrie Ian/Carrie Ian/Carrie Ian/Carrie
Week 7	Finalize Presentation Record Project Presentation Finalize Final Report Finalize GitHub Submit Final Report /Presentation	Ian Ian/Carrie Carrie Carrie Ian

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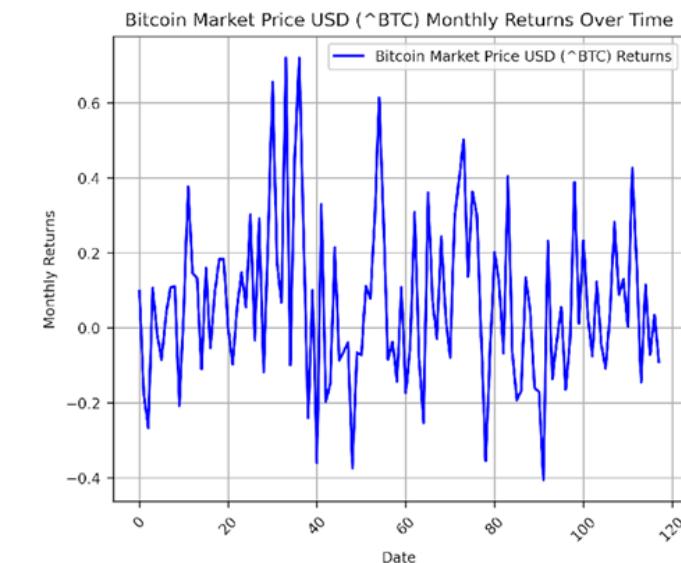
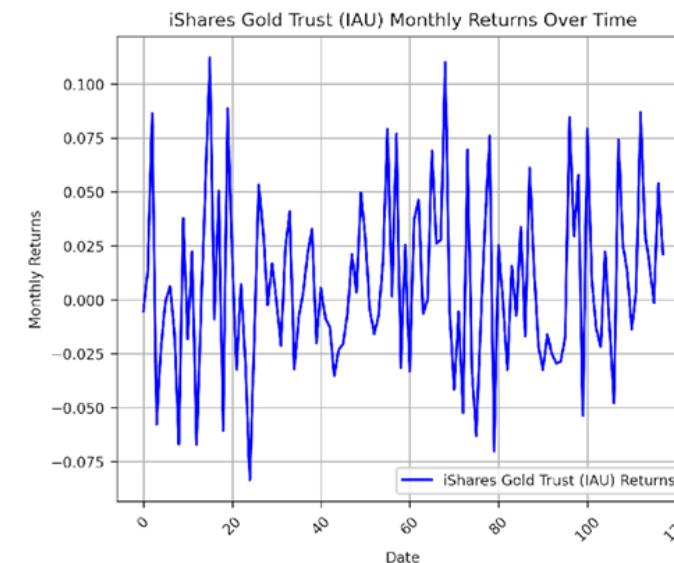
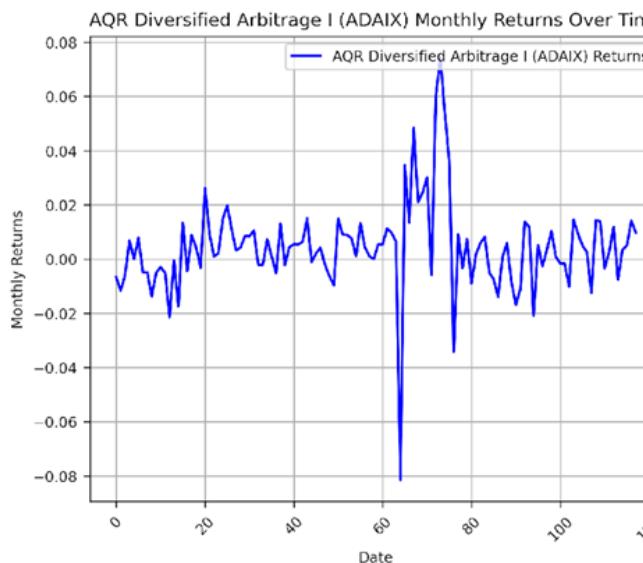
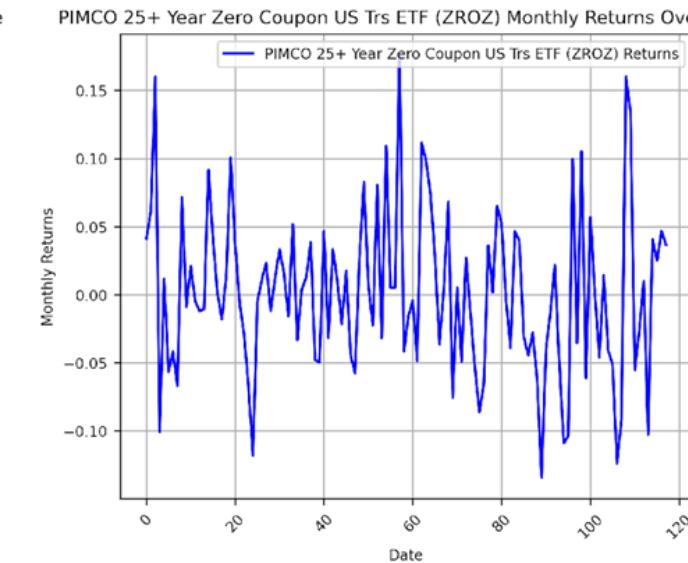
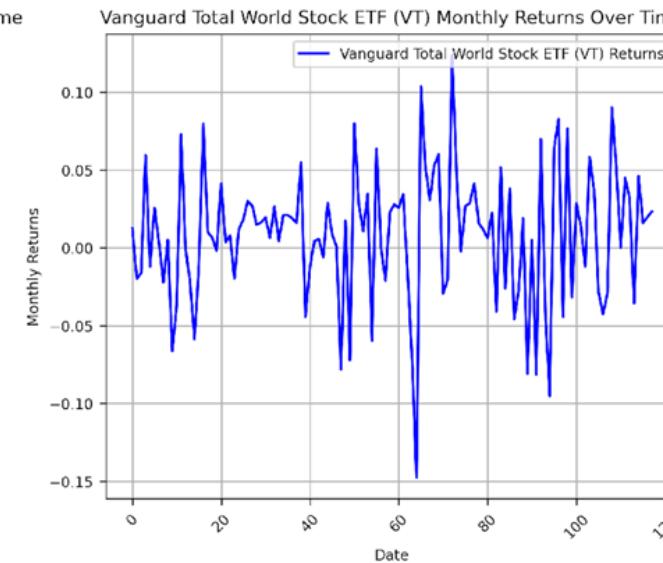
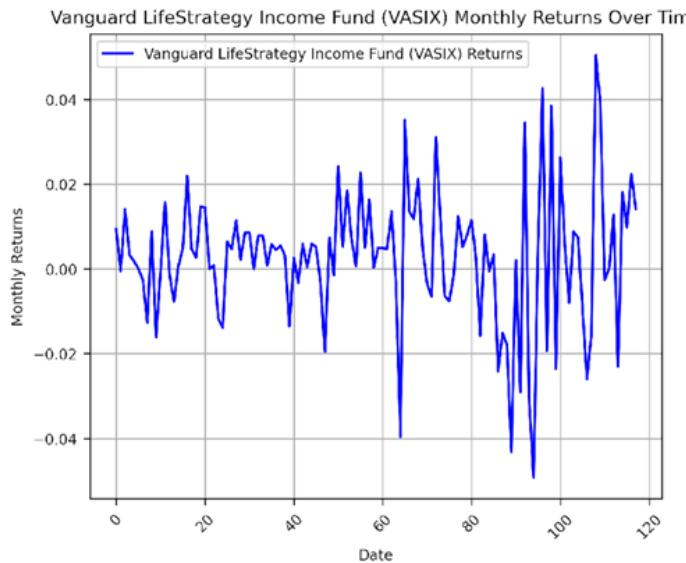
Backup Slides

Data Analytics and Modeling

- Monthly Return Time Series Plots
- Raw Return Histograms with Fitted Probability Distributions
- QQ-Plots
- Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns
- Asset Risk-Return Characteristics
- Model Analysis - Portfolio Weights Table
- Model Analysis - Risk Contribution Table
- Model Analysis - Performance Metrics Table
- Model Analysis - Annual Return Table
- Model Analysis - Regression Results Table
- Model Analysis - Fama French Factors
- Monte Carlo Analysis Table (36-months, 10,000 iterations)
- Quantitative Goodness of Fit Tests AIC, BIC, K-S
- Box and Whisker Plot

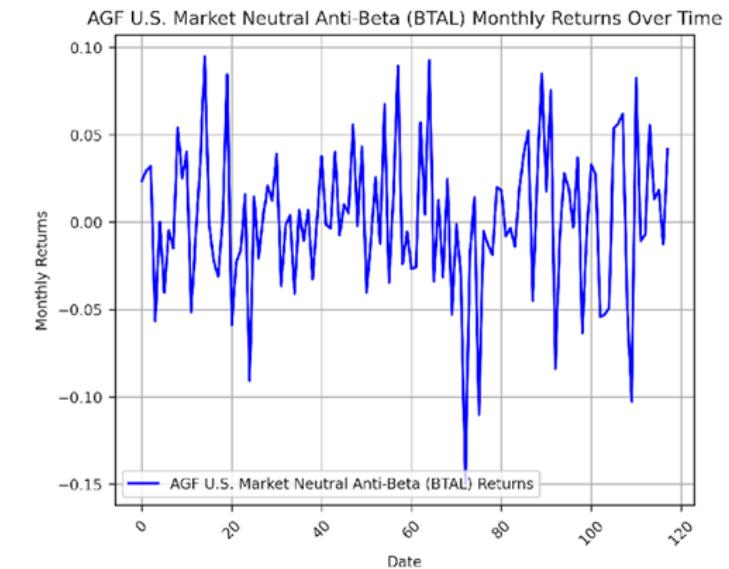
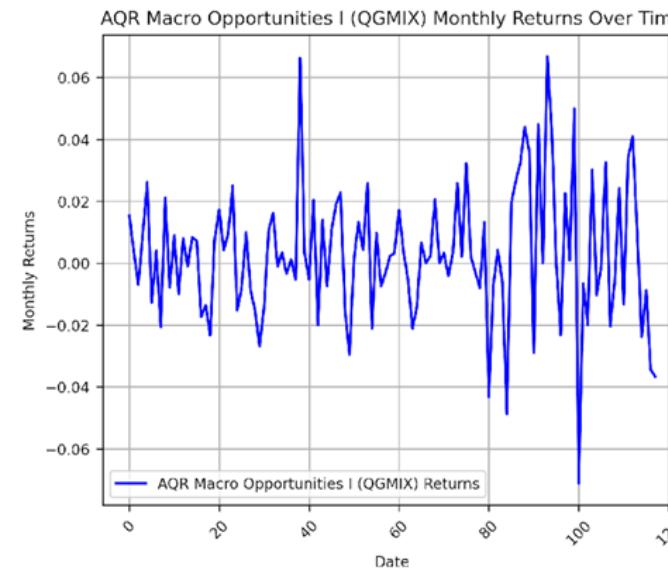
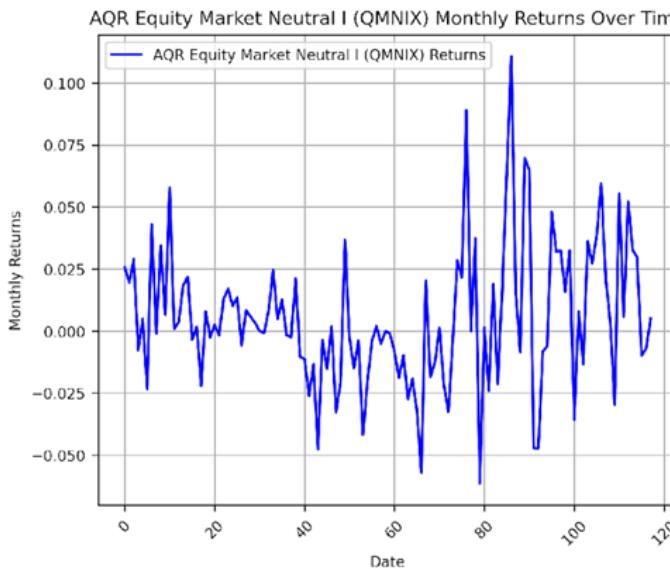
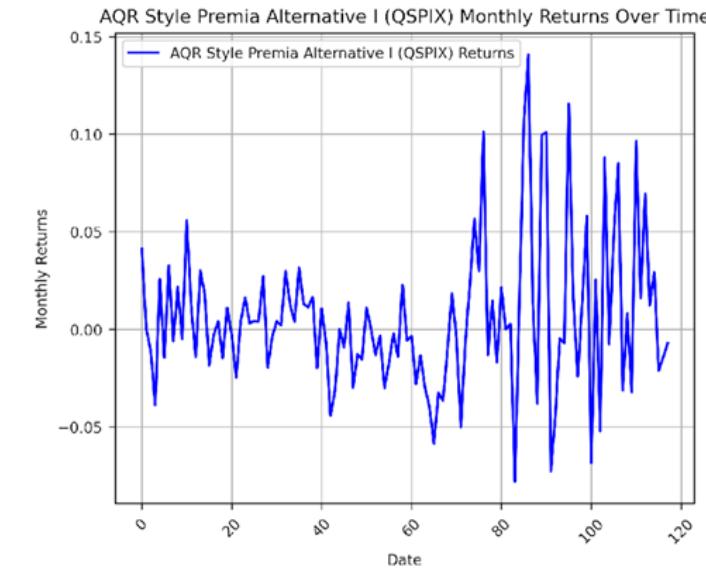
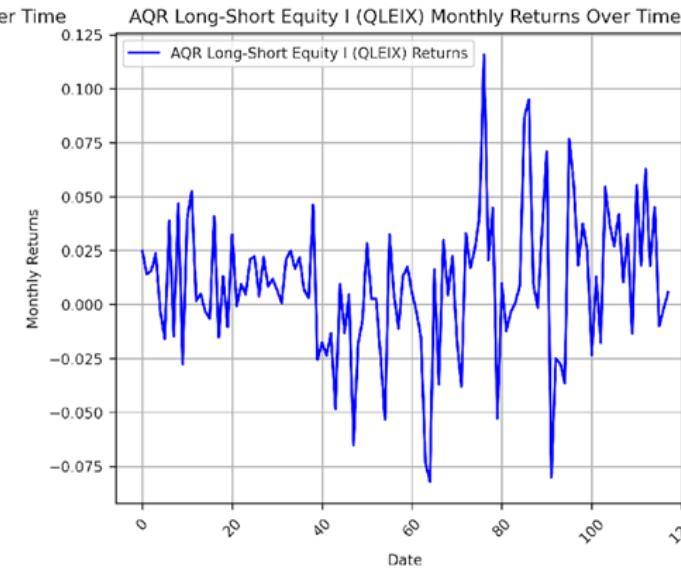
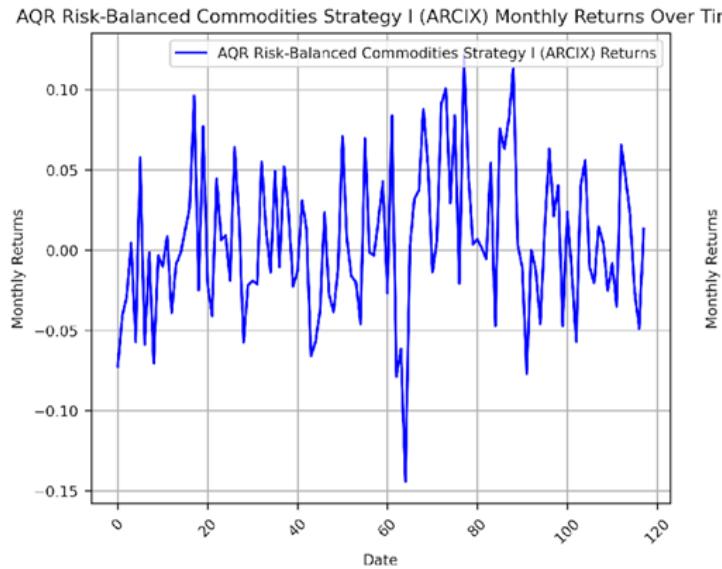
Monthly Return Time Series Plots

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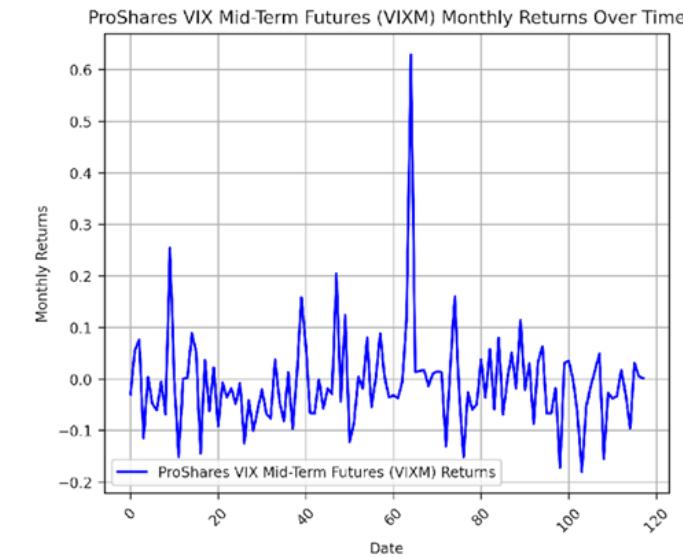
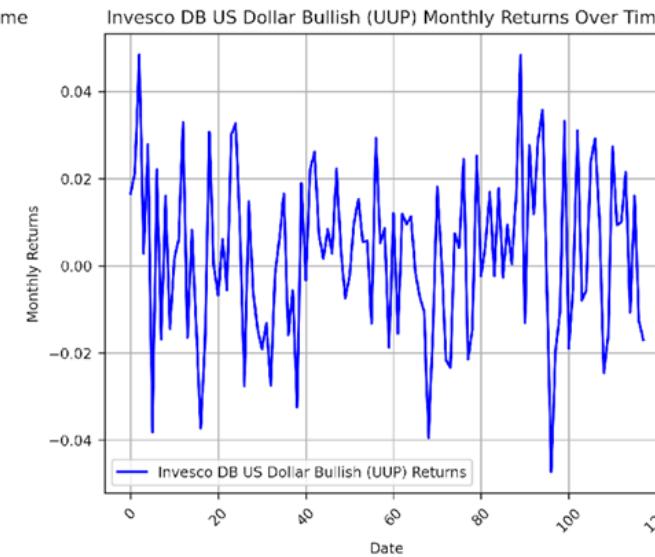
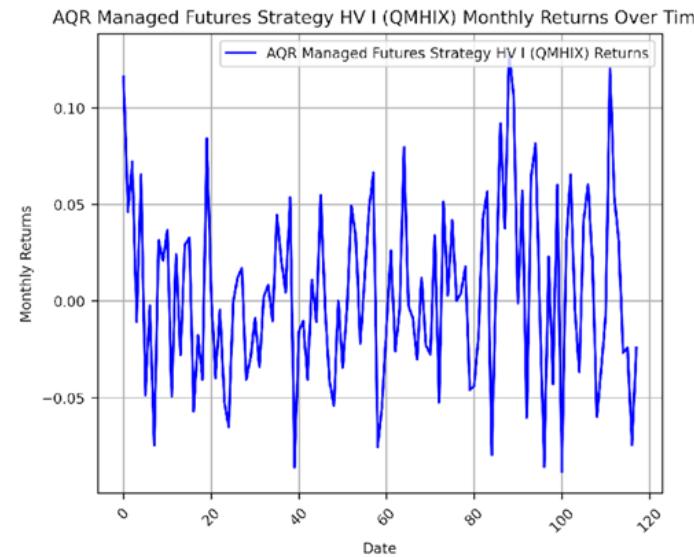
Monthly Return Time Series Plots

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Monthly Return Time Series Plots

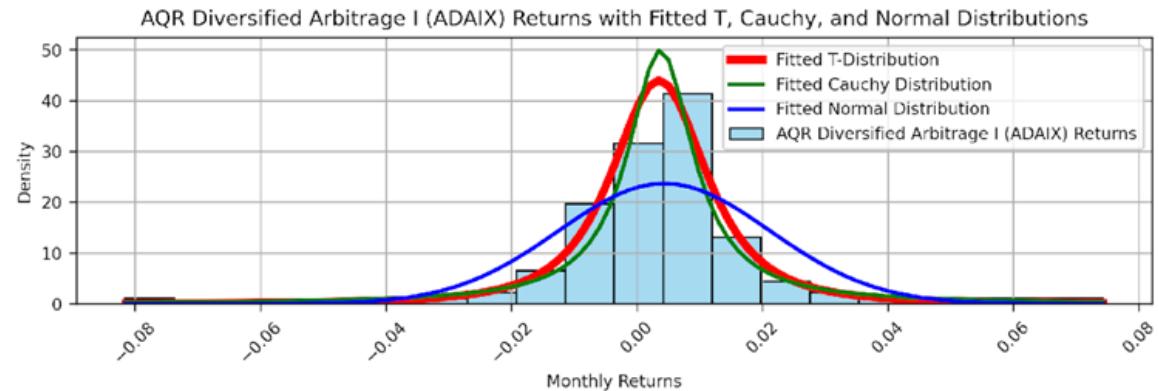
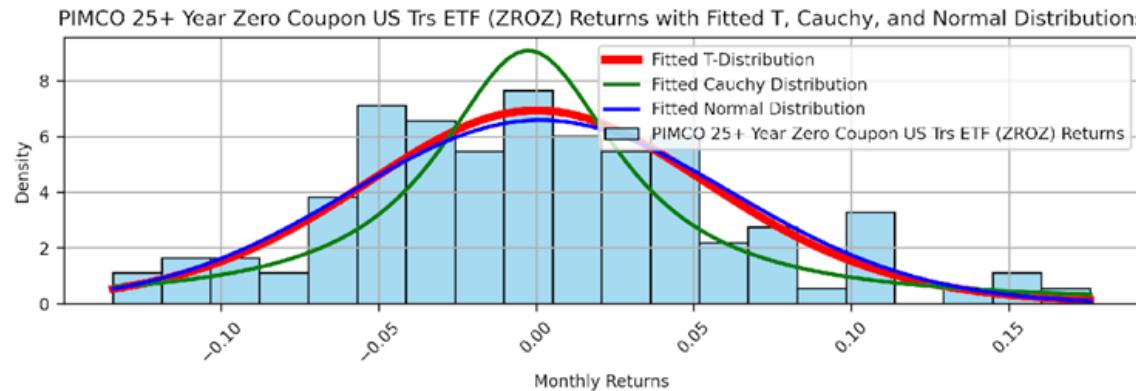
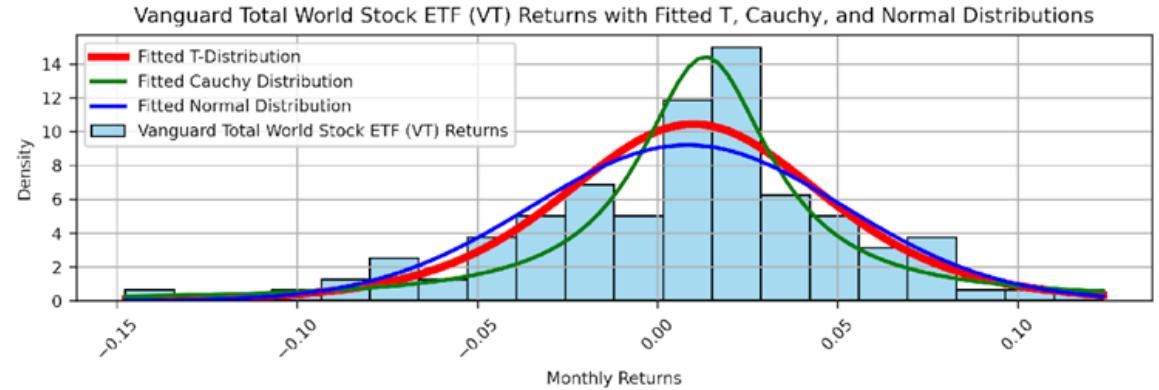
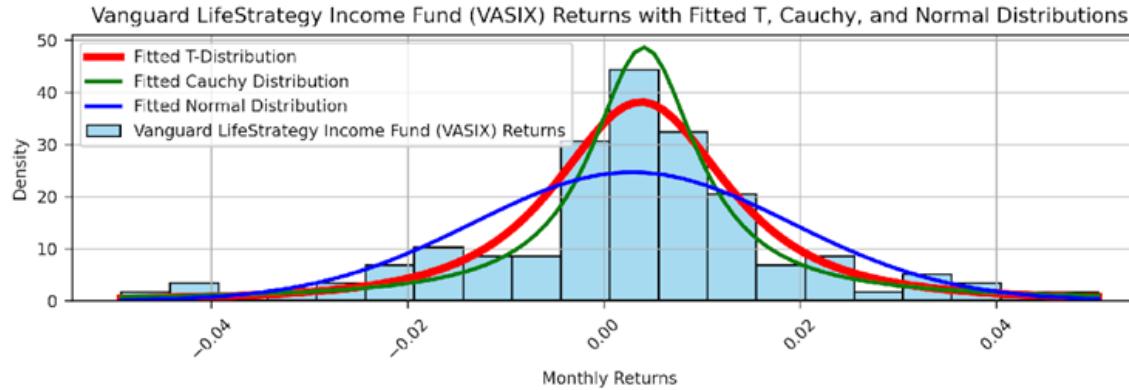
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Raw Return Histograms with Fitted Probability Distributions

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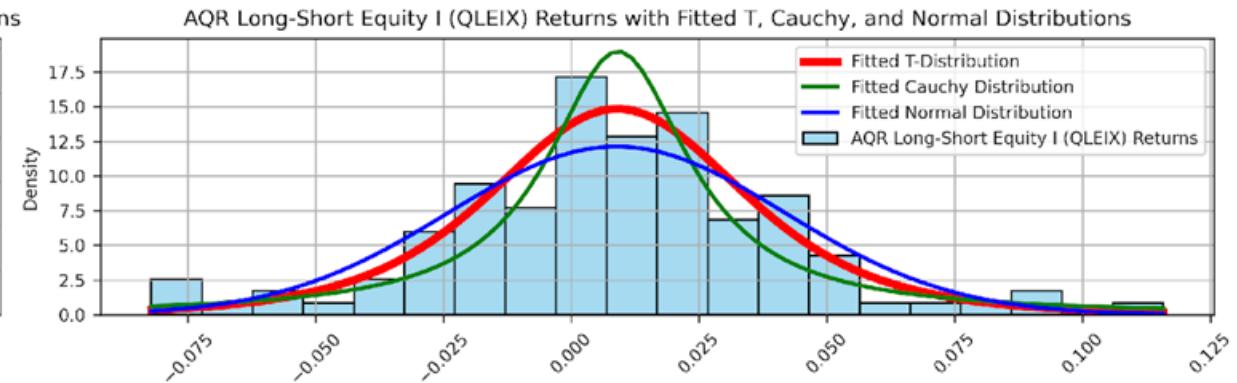
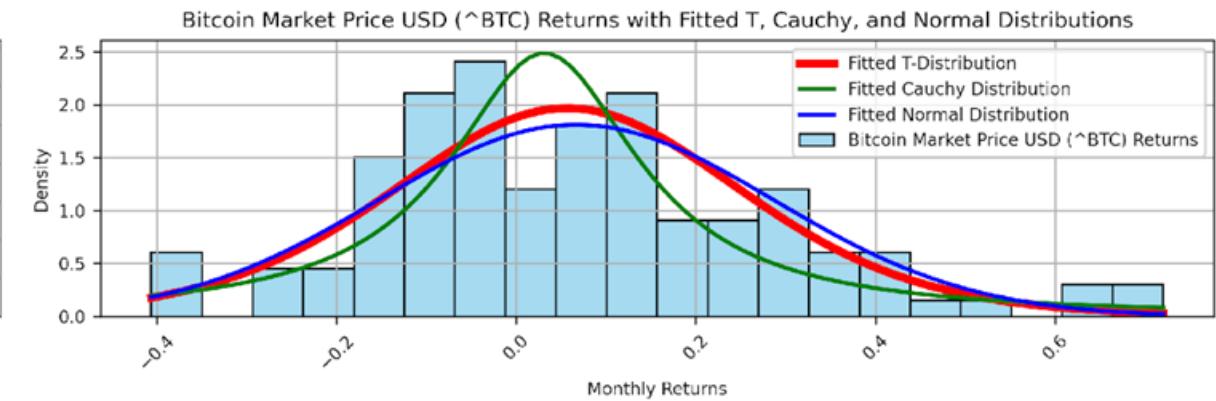
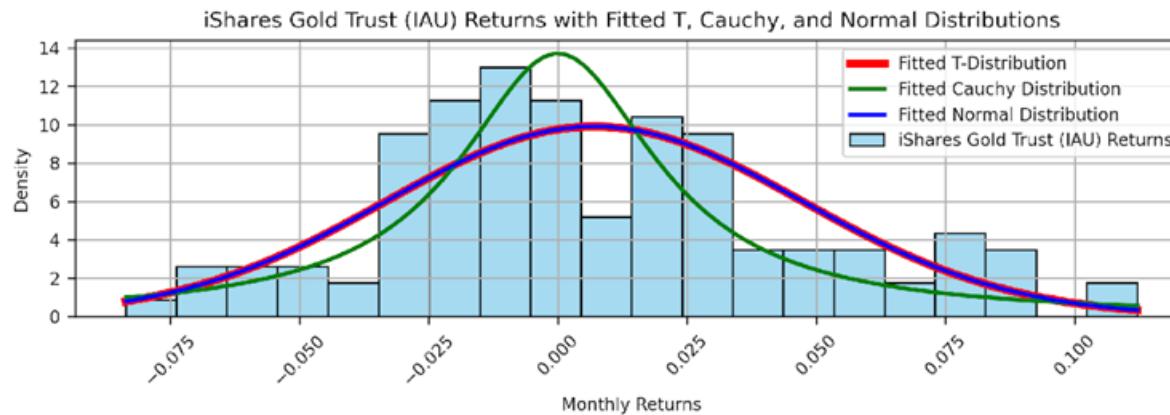
T, Cauchy, and Normal distributions



Raw Return Histograms with Fitted Probability Distributions

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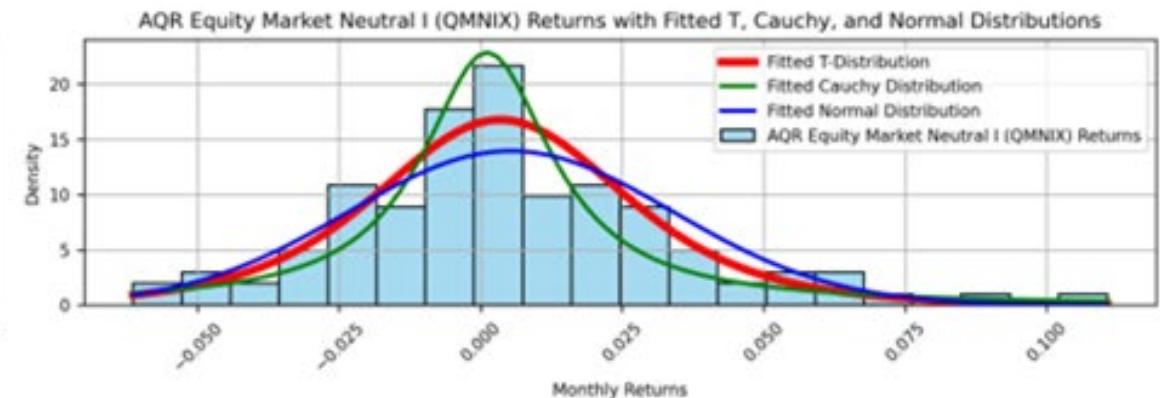
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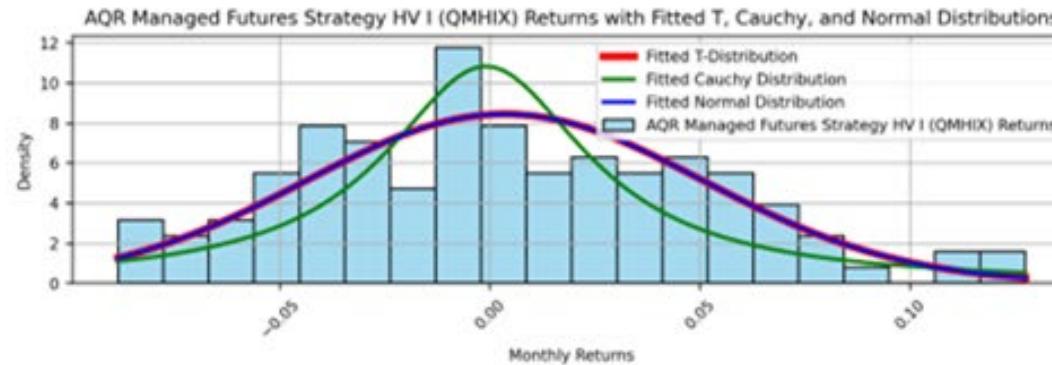
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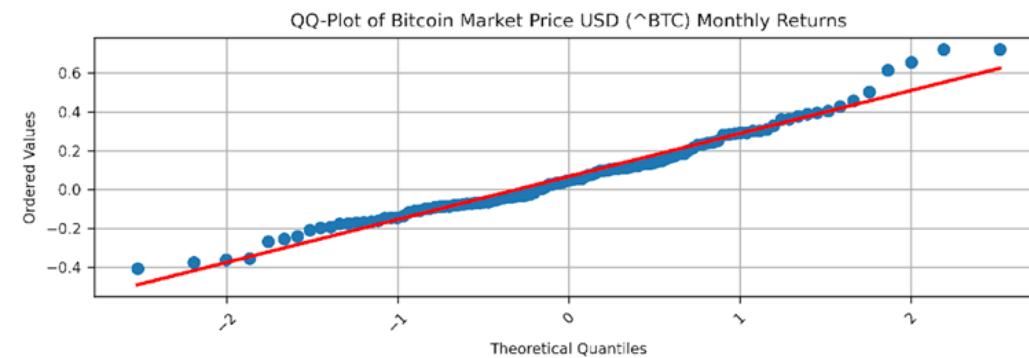
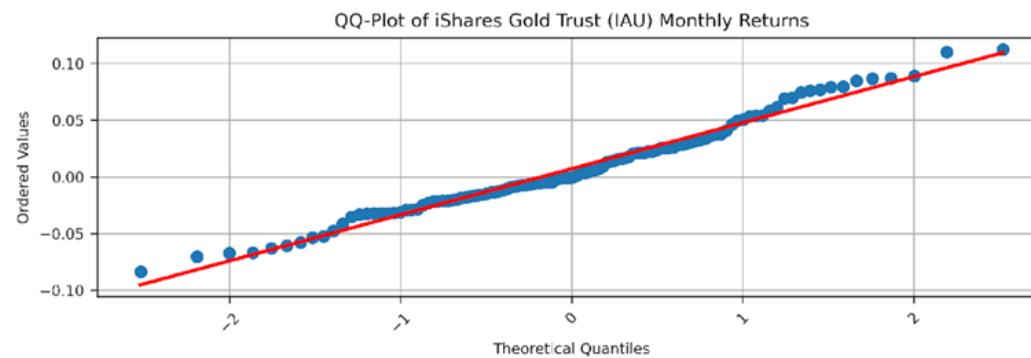
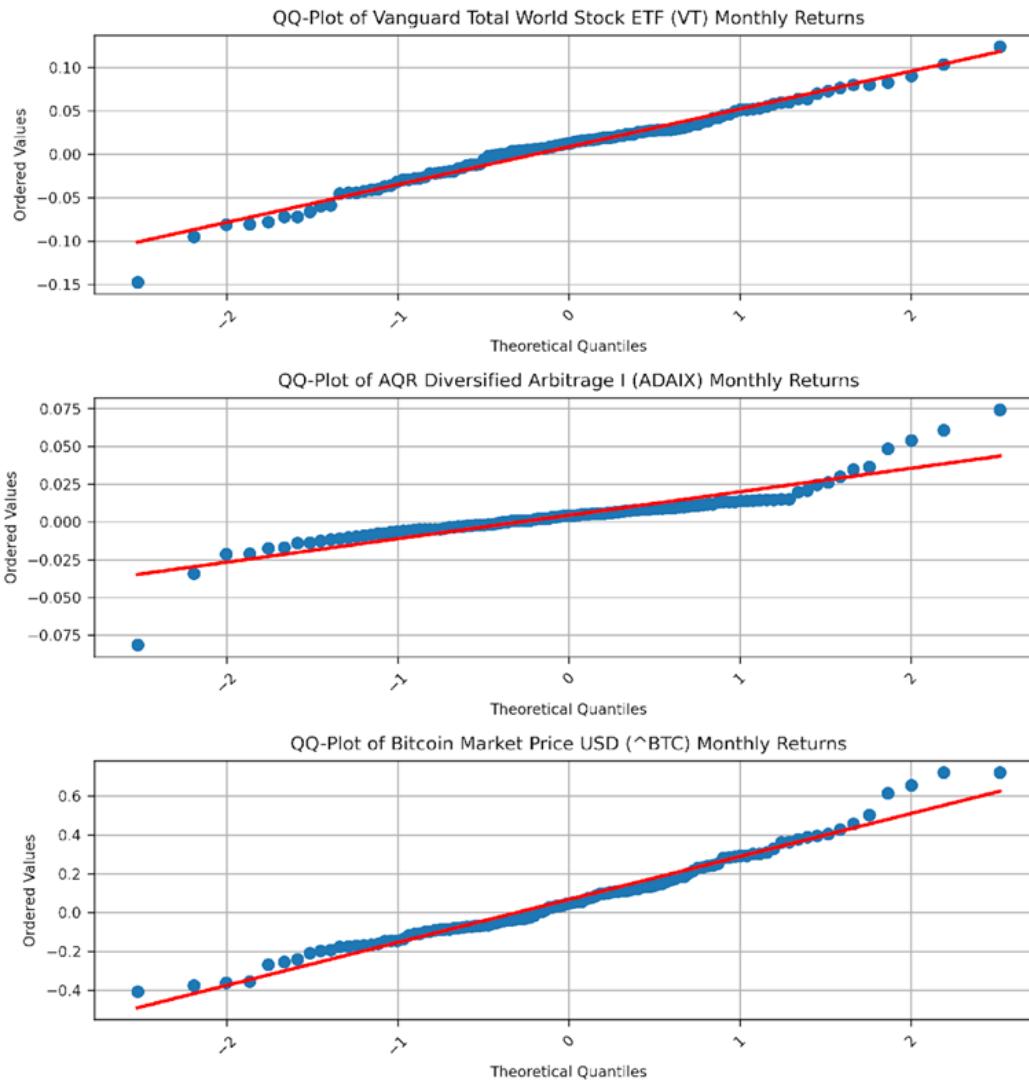
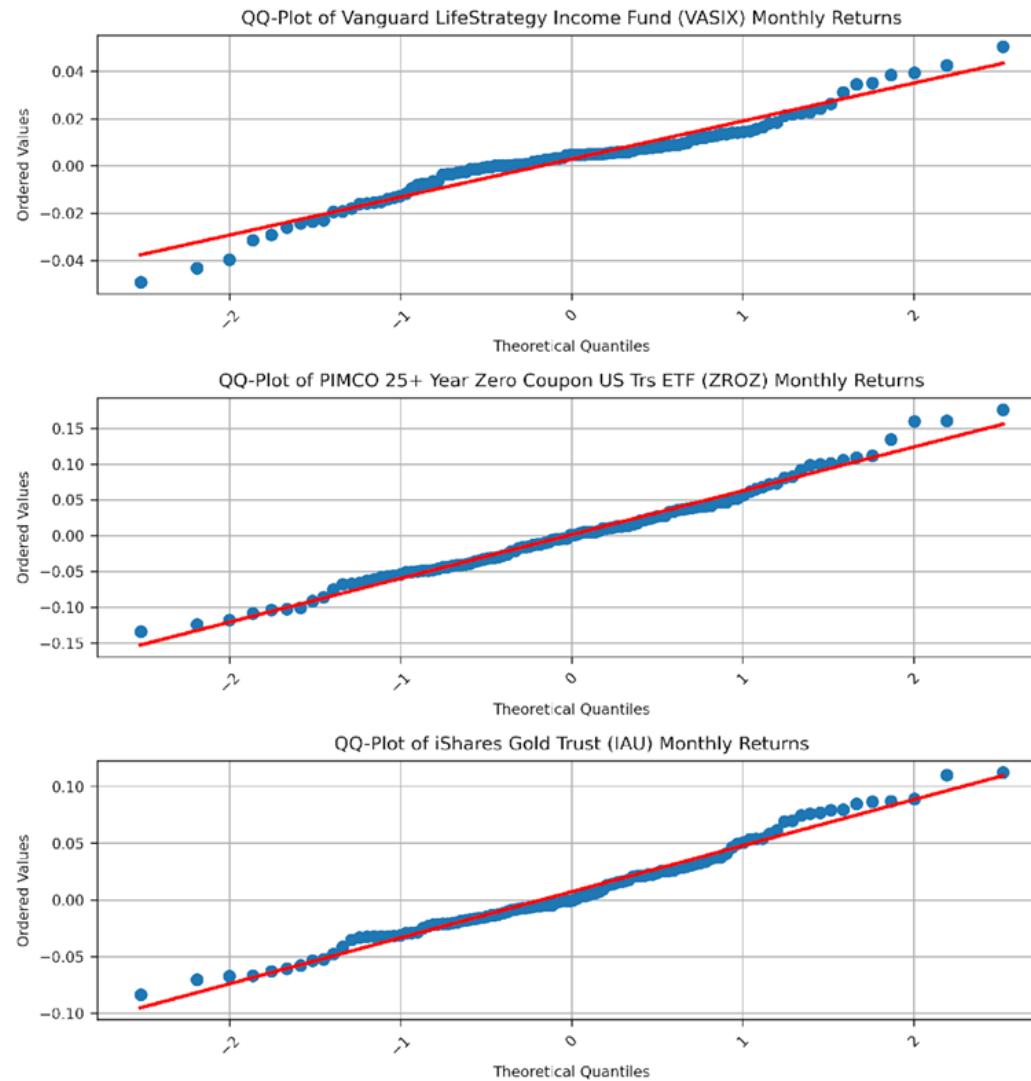
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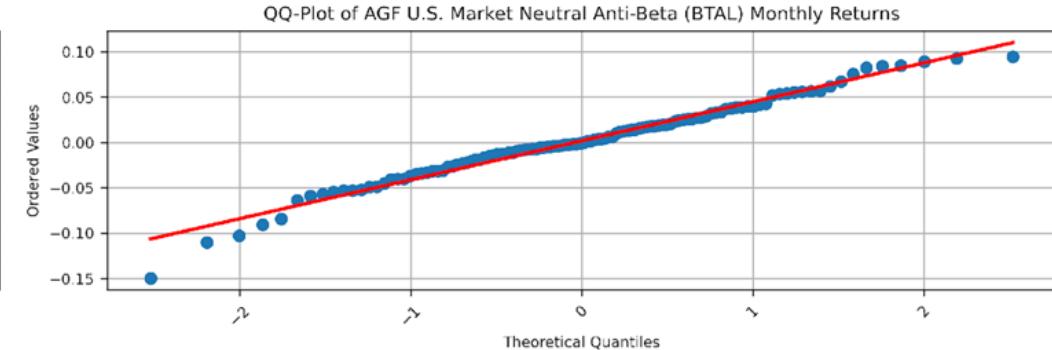
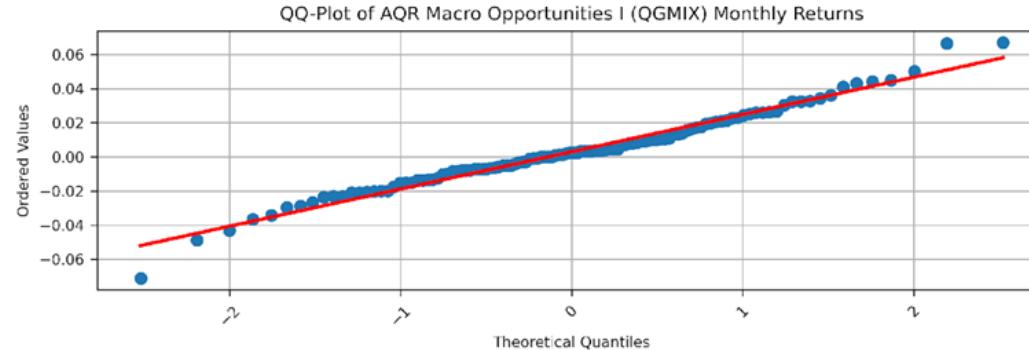
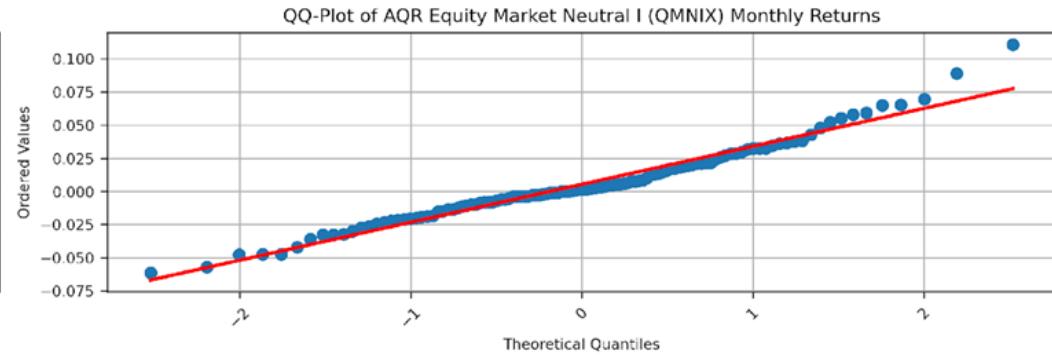
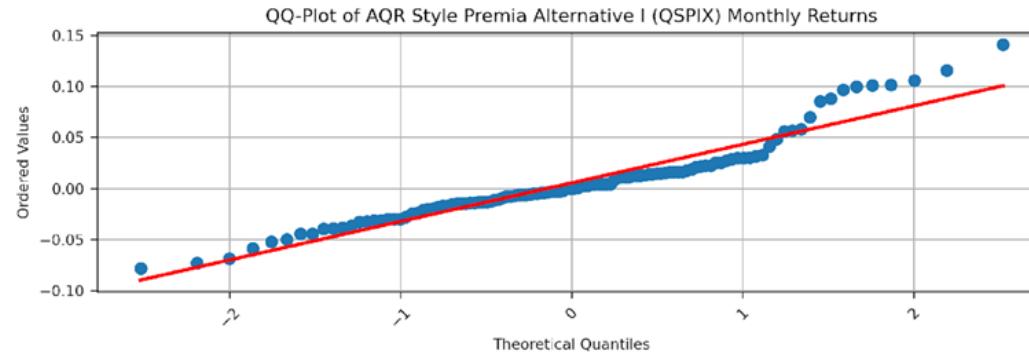
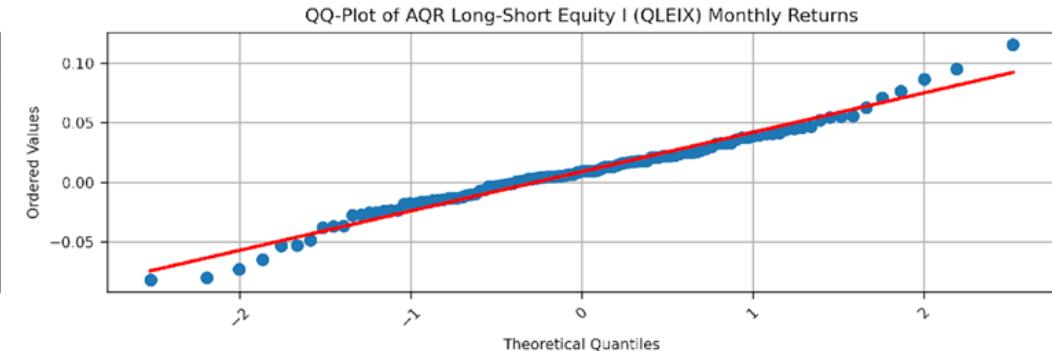
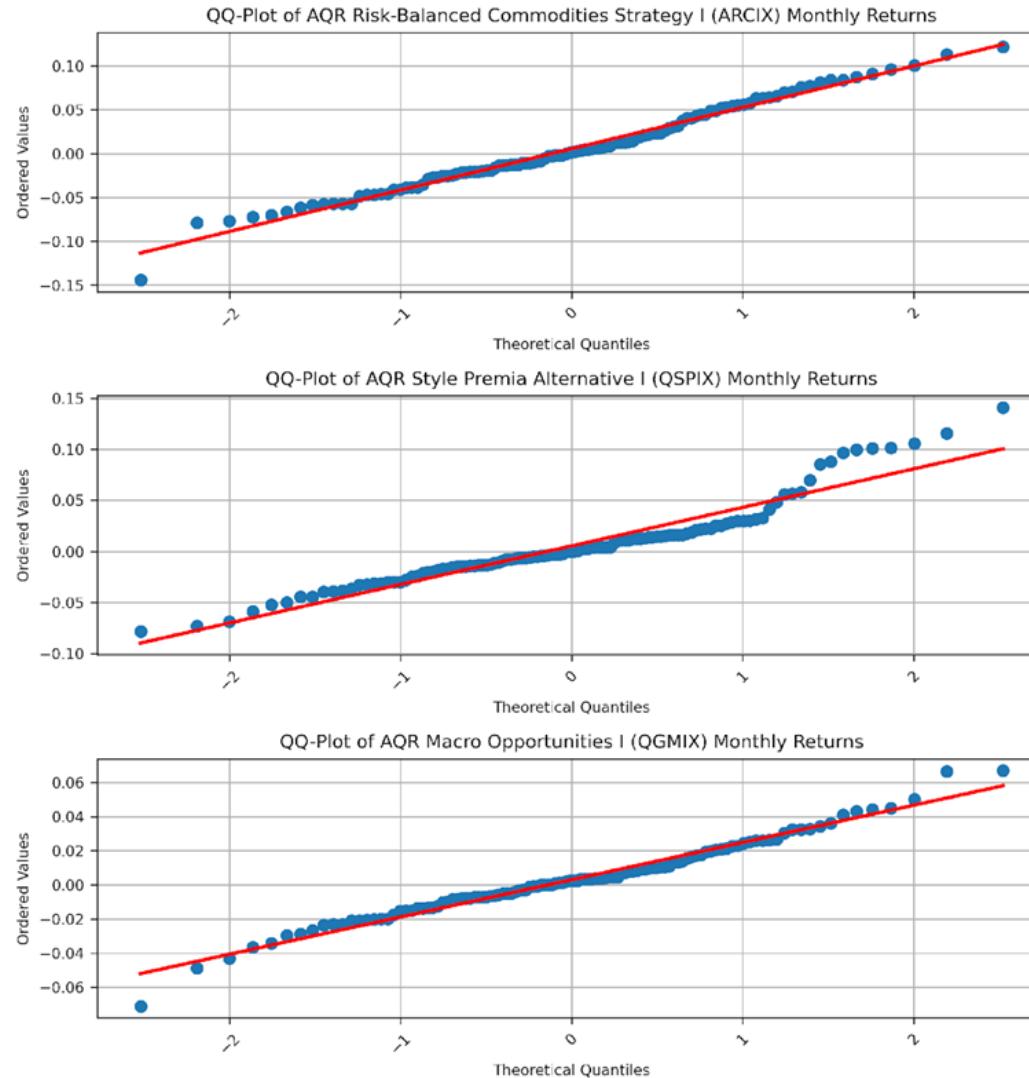
QQ-Plots

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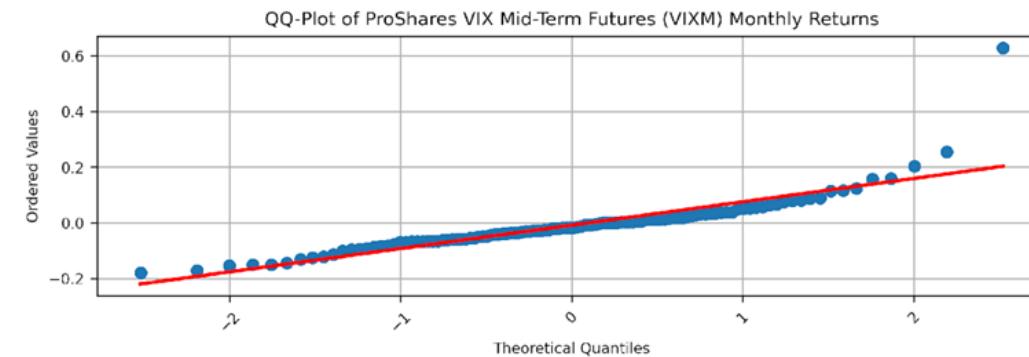
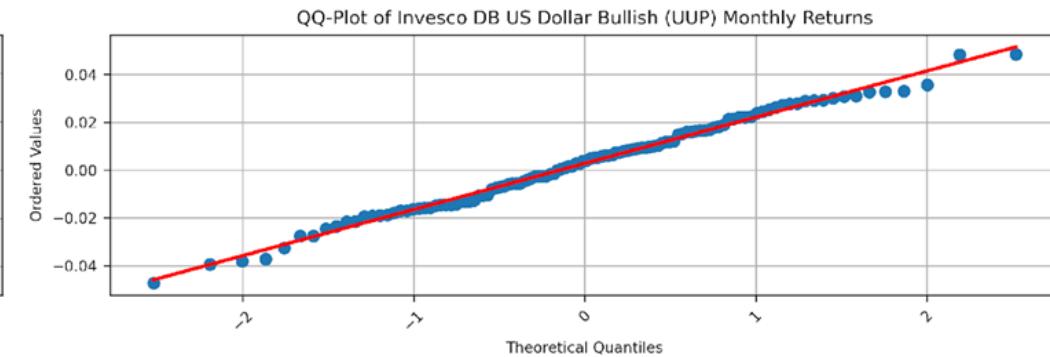
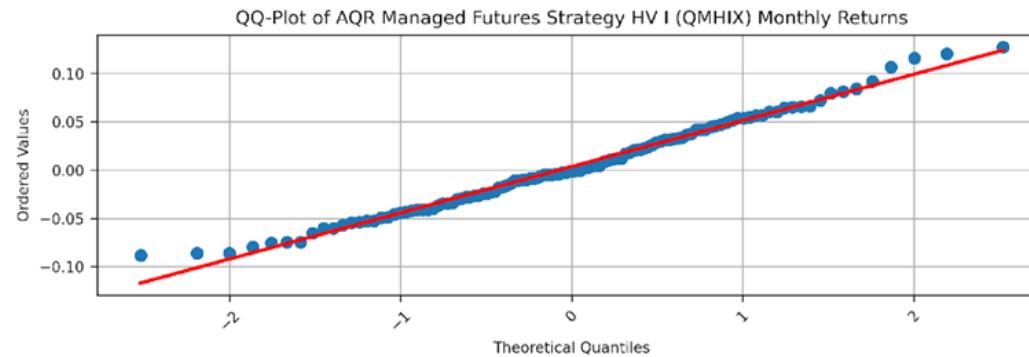
QQ-Plots

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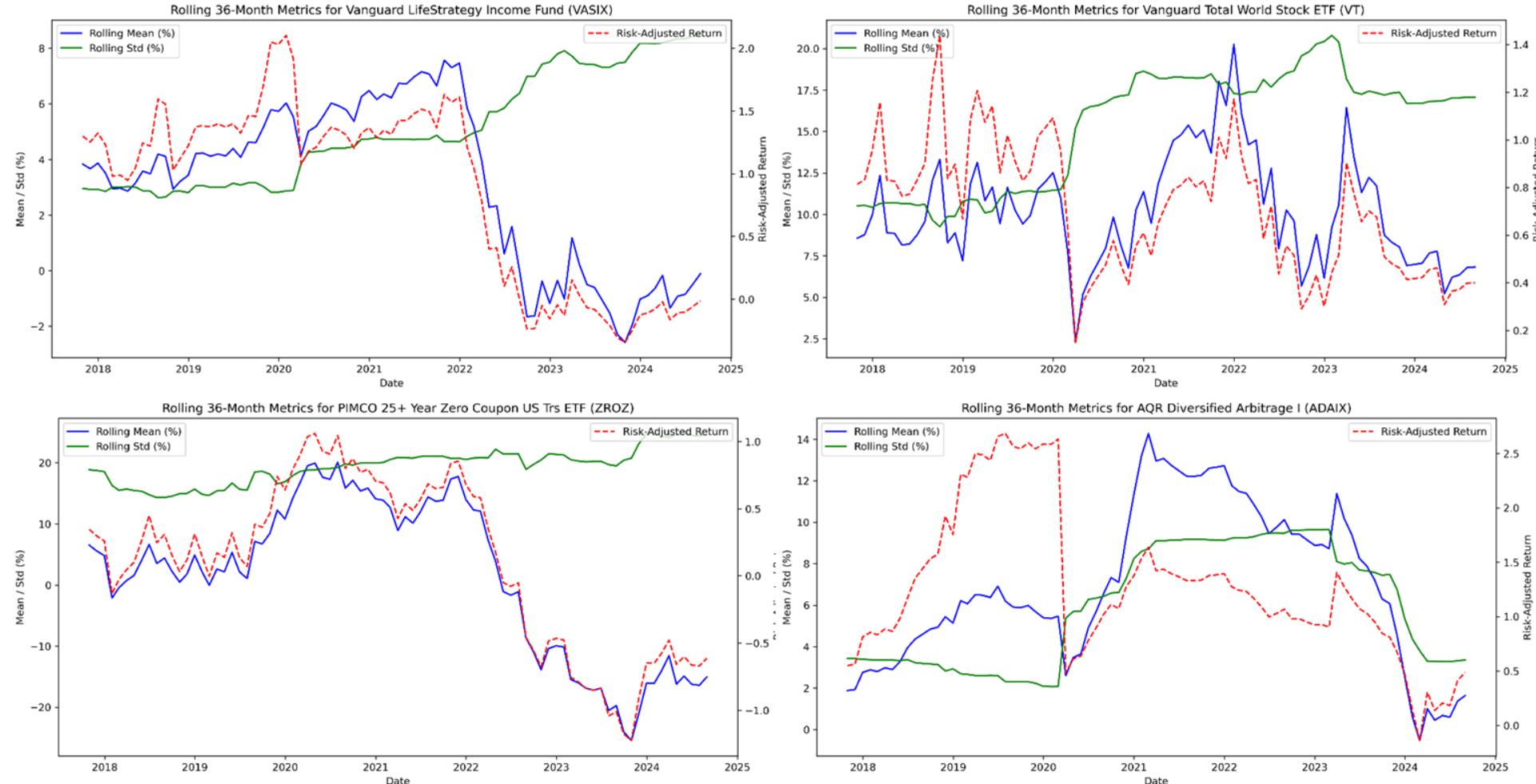
QQ-Plots

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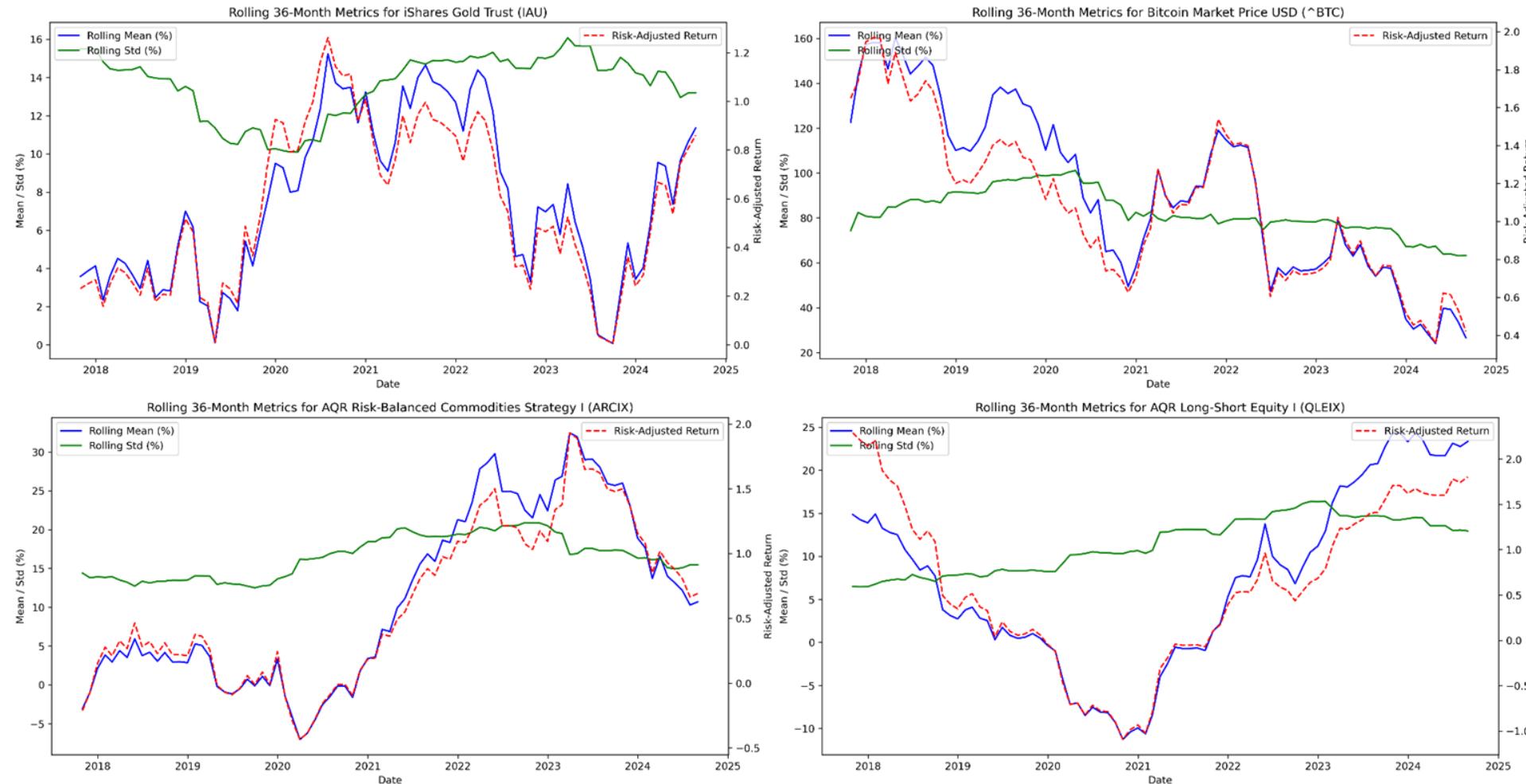
Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns

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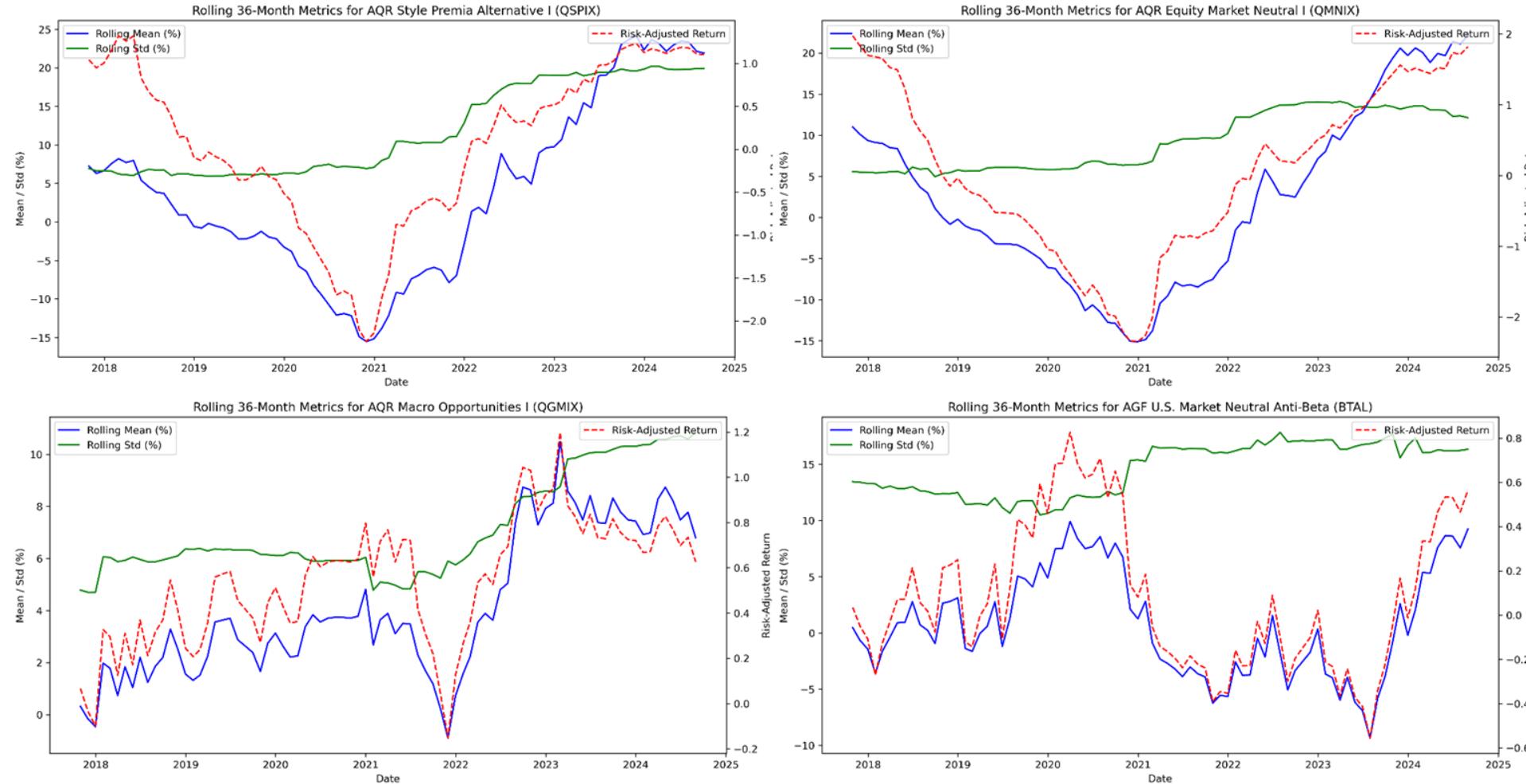
Rolling 36-Month Means, Standard Deviations, and Risk-Adjusted Returns

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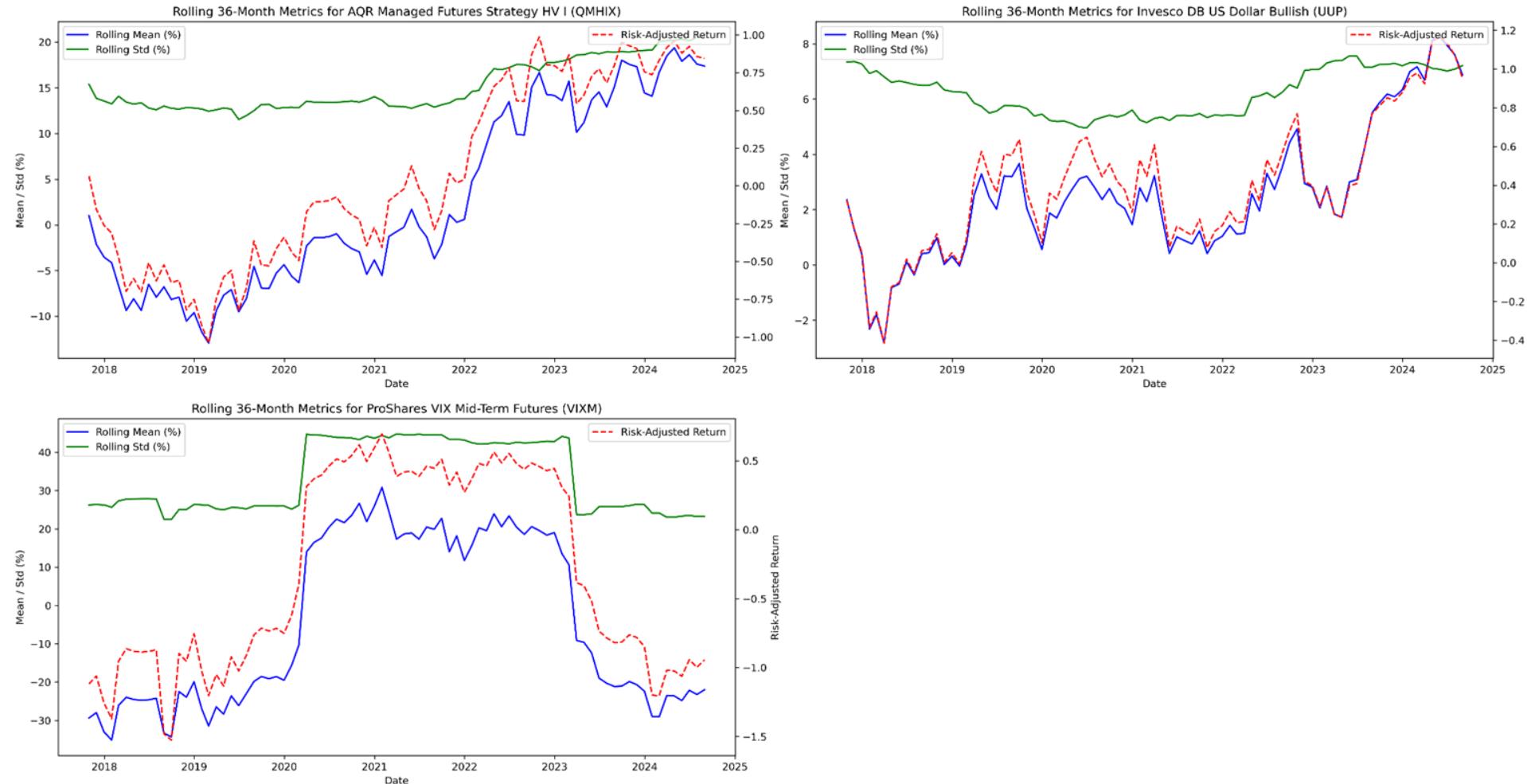
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Asset Risk-Return Characteristics

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1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53	0.53	0.22
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73	-0.02	-0.01
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15	0.55	0.20
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86	0.46	0.26
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82	1.02	0.67
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	5.40	16.25	39.60	-19.50	-30.09	0.28	0.15
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67	0.76	0.33
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58	0.33	0.20
9	AQR Equity Market Neutral I (QMNXI)	6.08	9.95	27.21	-19.52	-38.28	0.44	0.24
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00	0.20	0.09
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41	0.02	0.01
12	AQR Managed Futures Strategy HV I (QMHIIX)	2.99	16.43	49.99	-14.44	-36.26	0.14	0.08
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07	0.20	0.10
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79	-0.38	-0.23

Asset Risk-Return Characteristics

Risk and Return Characteristics for All Assets								
	Asset	CAGR (%)	Annualized Std Dev (%)	Best Year (%)	Worst Year (%)	Max Drawdown (%)	Sharpe Ratio	Sortino Ratio
0	Vanguard LifeStrategy Income Fund (VASIX)	3.35	5.63	12.05	-13.93	-16.72	0.26	0.10
1	Vanguard Total World Stock ETF (VT)	9.29	15.06	26.82	-18.02	-25.53	0.53	0.22
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-0.52	21.06	24.52	-41.31	-61.73	-0.02	-0.01
3	AQR Diversified Arbitrage I (ADAIX)	5.19	5.86	25.25	-4.87	-8.15	0.55	0.20
4	iShares Gold Trust (IAU)	7.75	14.01	25.02	-10.59	-17.86	0.46	0.26
5	Bitcoin Market Price USD (^BTC)	68.78	76.62	1271.14	-71.76	-73.82	1.02	0.67
6	AQR Risk-Balanced Commodities Strategy I (ARCIX)	5.40	16.25	39.60	-19.50	-30.09	0.28	0.15
7	AQR Long-Short Equity I (QLEIX)	10.50	11.45	31.09	-16.33	-33.67	0.76	0.33
8	AQR Style Premia Alternative I (QSPIX)	5.76	13.44	30.61	-21.96	-39.58	0.33	0.20
9	AQR Equity Market Neutral I (QMNXI)	6.08	9.95	27.21	-19.52	-38.28	0.44	0.24
10	AQR Macro Opportunities I (QGMIX)	3.24	7.55	29.27	-4.55	-10.00	0.20	0.09
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	1.16	14.85	20.49	-15.09	-35.41	0.02	0.01
12	AQR Managed Futures Strategy HV I (QMHIIX)	2.99	16.43	49.99	-14.44	-36.26	0.14	0.08
13	Invesco DB US Dollar Bullish (UUP)	3.15	6.63	9.46	-9.12	-12.07	0.20	0.10
14	ProShares VIX Mid-Term Futures (VIXM)	-13.84	32.43	72.39	-50.05	-79.79	-0.38	-0.23

Model Analysis

Portfolio Weights Table

Portfolio Weights Table (%):

	Asset	Risk Parity	Min Variance	Max Diversification
	Vanguard Total World Stock ETF (VT)	11.62	15.84	23.15
PIMCO	25+ Year Zero Coupon US Trs ETF (ZROZ)	4.75	2.01	3.38
	AQR Diversified Arbitrage I (ADAIIX)	15.04	22.46	8.49
	iShares Gold Trust (IAU)	4.05	3.29	0.00
	Bitcoin Market Price USD (^BTC)	0.92	0.00	0.46
AQR	Risk-Balanced Commodities Strategy I (ARCIIX)	4.27	0.31	4.08
	AQR Long-Short Equity I (QLEIX)	4.58	0.00	0.00
	AQR Style Premia Alternative I (QSPIX)	3.82	0.00	0.00
	AQR Equity Market Neutral I (QMNXI)	5.59	9.09	9.16
	AQR Macro Opportunities I (QGMIX)	8.89	7.80	8.07
AGF	U.S. Market Neutral Anti-Beta (BTAL)	6.13	6.69	8.73
	AQR Managed Futures Strategy HV I (QMHIX)	2.68	0.00	0.00
	Invesco DB US Dollar Bullish (UUP)	22.30	27.87	26.54
	ProShares VIX Mid-Term Futures (VIXM)	5.36	4.64	7.92

Model Analysis

Risk Contribution Table

Risk Contribution Table (%):

	Asset	Risk Parity	Min Variance	Max Diversification
	Vanguard Total World Stock ETF (VT)	7.19	16.90	27.12
PIMCO	25+ Year Zero Coupon US Trs ETF (ZROZ)	7.11	1.94	5.54
	AQR Diversified Arbitrage I (ADAIIX)	7.09	22.05	3.87
	iShares Gold Trust (IAU)	7.14	3.30	0.00
	Bitcoin Market Price USD (^BTC)	7.10	0.00	2.74
AQR	Risk-Balanced Commodities Strategy I (ARCIIX)	7.18	0.29	5.16
	AQR Long-Short Equity I (QLEIX)	7.15	0.00	0.00
	AQR Style Premia Alternative I (QSPIX)	7.16	0.00	0.00
	AQR Equity Market Neutral I (QMNXI)	7.14	9.25	7.09
	AQR Macro Opportunities I (QGMIX)	7.16	7.90	4.74
AGF	U.S. Market Neutral Anti-Beta (BTAL)	7.11	6.49	10.08
	AQR Managed Futures Strategy HV I (QMHIX)	7.17	0.00	0.00
	Invesco DB US Dollar Bullish (UUP)	7.16	27.48	13.68
	ProShares VIX Mid-Term Futures (VIXM)	7.14	4.40	19.98

Model Analysis

Performance Metrics Table

Performance Metrics Table:

	Risk Parity	Minimum Variance	Maximum Diversification	VASIX (Benchmark)
CAGR (%)	5.38	4.66	4.71	3.38
Standard Deviation (%)	2.93	2.35	2.61	5.63
Maximum Drawdown (%)	-2.87	-2.21	-2.77	-16.72

Model Analysis

Annual Return Table

Annual Return Table (%):

Date	Risk Parity (%)	Minimum Variance (%)	Maximum Diversification (%)	VASIX (Benchmark) (%)
2014-12-31	2.11	1.77	1.77	0.89
2015-12-31	1.36	1.39	1.29	0.23
2016-12-31	4.17	3.82	3.35	4.60
2017-12-31	3.51	-0.03	0.39	6.97
2018-12-31	-0.34	2.60	1.60	-1.06
2019-12-31	7.19	6.64	7.48	12.05
2020-12-31	9.11	8.56	9.61	9.14
2021-12-31	7.99	5.97	7.47	1.92
2022-12-31	5.71	4.01	3.29	-13.93
2023-12-31	4.62	4.07	3.03	9.48
2024-12-31	7.27	6.92	6.94	5.21

Model Analysis

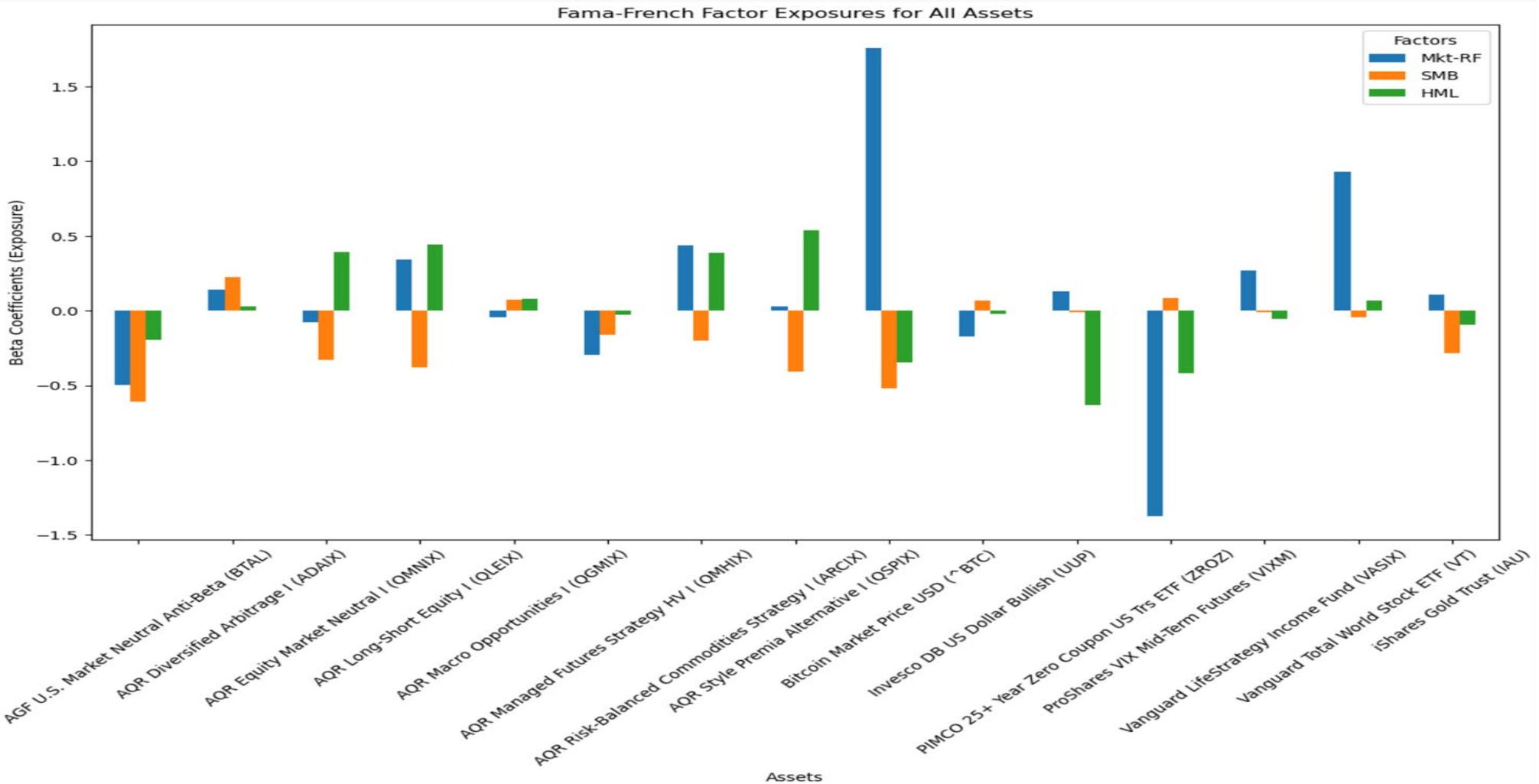
Regression Results Table

Regression Results Against Benchmark (VASIX)

	Portfolio	R2	Intercept (Annualized)	Intercept t-stat	Intercept p-value	Beta	Beta t-stat	Beta p-value
0	Risk Parity	0.03	4.96	5.26	0.0000	0.08	1.73	0.0864
1	Minimum Variance	0.03	4.33	5.74	0.0000	0.07	1.75	0.0826
2	Maximum Diversification	0.05	4.24	5.13	0.0000	0.11	2.53	0.0129

Model Analysis

Fama French Factors



Monte Carlo Analysis, 50th Percentile (36-mo., 10,000 iterations)

Asset	Portfolio End Balance (\$)	Annual Compounded Return (%)	Annualized Volatility (%)	Maximum Drawdown (%)
Vanguard LifeStrategy Income Fund (VASIX)	11,015	3.27	6.88	-8.18
Vanguard Total World Stock ETF (VT)	12,825	8.65	18.40	-20.64
PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	9,464	-1.82	25.73	-37.05
AQR Diversified Arbitrage I (ADAIX)	11,612	5.11	7.16	-7.51
iShares Gold Trust (IAU)	12,310	7.17	17.11	-19.83
Bitcoin Market Price USD (^BTC)	23,976	33.84	93.60	-74.97
AQR Risk-Balanced Commodities Strategy I (ARCIIX)	11,458	4.64	19.85	-25.07
AQR Long-Short Equity I (QLEIX)	13,357	10.13	13.98	-14.22
AQR Style Premia Alternative I (QSPIX)	11,650	5.22	16.41	-20.20
AQR Equity Market Neutral I (QMNXI)	11,843	5.80	12.16	-14.04
AQR Macro Opportunities I (QGMIX)	10,955	3.09	9.23	-11.74
AGF U.S. Market Neutral Anti-Beta (BTAL)	10,170	0.56	18.14	-26.03
AQR Managed Futures Strategy HV I (QMHIX)	10,683	2.23	20.07	-27.10
Invesco DB US Dollar Bullish (UUP)	10,940	3.04	8.10	-10.11
ProShares VIX Mid-Term Futures (VIXM)	5,676	-17.20	39.62	-62.35

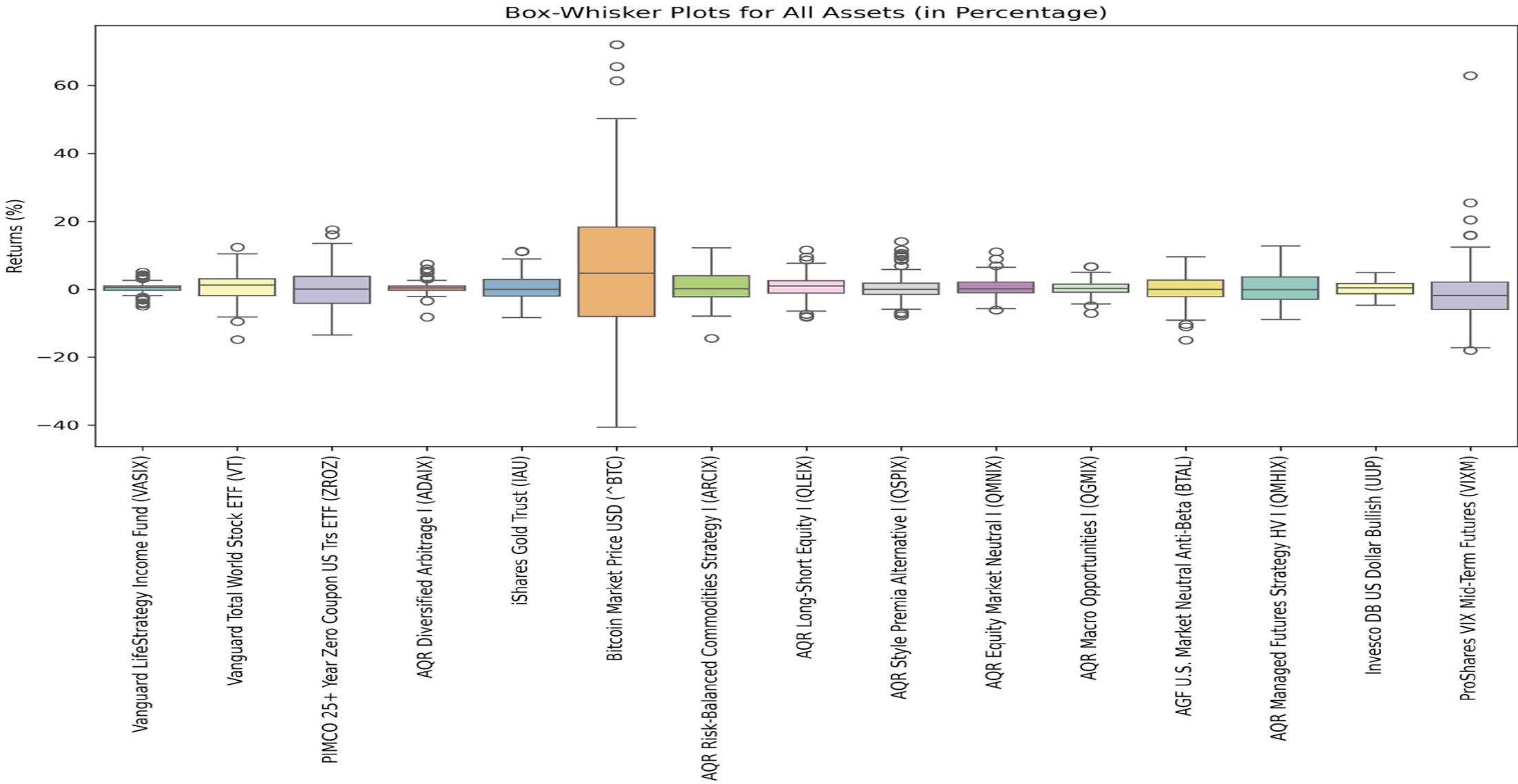
Quantitative Goodness of Fit Tests AIC, BIC, K-S

	Asset	AIC_T	AIC_Cauchy	AIC_Normal	BIC_T	BIC_Cauchy	BIC_Normal	K-S_T	K-S_Cauchy	K-S_Normal
0	Vanguard LifeStrategy Income Fund (VASIX)	-647.000	-639.908	-634.216	-638.688	-634.366	-628.675	0.058	0.054	0.122
1	Vanguard Total World Stock ETF (VT)	-403.166	-379.327	-402.084	-394.854	-373.786	-396.542	0.066	0.072	0.089
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-321.459	-288.056	-322.976	-313.147	-282.515	-317.435	0.039	0.083	0.052
3	AQR Diversified Arbitrage I (ADAIX)	-679.596	-667.710	-624.802	-671.284	-662.168	-619.261	0.047	0.070	0.169
4	iShares Gold Trust (IAU)	-417.207	-382.092	-419.207	-408.895	-376.550	-413.665	0.078	0.094	0.078
5	Bitcoin Market Price USD (^BTC)	-17.637	15.443	-18.210	-9.325	20.985	-12.669	0.071	0.097	0.076
6	AQR Risk-Balanced Commodities Strategy I (ARCIIX)	-382.235	-345.458	-384.209	-373.923	-339.916	-378.668	0.066	0.097	0.067
7	AQR Long-Short Equity I (QLEIX)	-471.236	-448.901	-466.863	-462.924	-443.360	-461.322	0.034	0.059	0.064
8	AQR Style Premia Alternative I (QSPIX)	-444.950	-432.415	-429.054	-436.638	-426.874	-423.513	0.055	0.084	0.134
9	AQR Equity Market Neutral I (QMNXIX)	-503.627	-483.176	-499.914	-495.315	-477.635	-494.372	0.063	0.077	0.101
10	AQR Macro Opportunities I (QGMIX)	-567.909	-544.492	-564.954	-559.597	-538.950	-559.412	0.068	0.067	0.084
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	-406.536	-379.027	-405.510	-398.224	-373.485	-399.969	0.042	0.077	0.060
12	AQR Managed Futures Strategy HV I (QMHIIX)	-379.619	-334.573	-381.619	-371.307	-329.032	-376.078	0.059	0.103	0.059
13	Invesco DB US Dollar Bullish (UUP)	-593.853	-545.432	-595.853	-585.541	-539.890	-590.312	0.054	0.099	0.054
14	ProShares VIX Mid-Term Futures (VIXM)	-270.022	-252.818	-221.081	-261.710	-247.276	-215.539	0.048	0.073	0.140

Quantitative Goodness of Fit Tests AIC, BIC, K-S

	Asset	AIC_T	AIC_Cauchy	AIC_Normal	BIC_T	BIC_Cauchy	BIC_Normal	K-S_T	K-S_Cauchy	K-S_Normal
0	Vanguard LifeStrategy Income Fund (VASIX)	-647.000	-639.908	-634.216	-638.688	-634.366	-628.675	0.058	0.054	0.122
1	Vanguard Total World Stock ETF (VT)	-403.166	-379.327	-402.084	-394.854	-373.786	-396.542	0.066	0.072	0.089
2	PIMCO 25+ Year Zero Coupon US Trs ETF (ZROZ)	-321.459	-288.056	-322.976	-313.147	-282.515	-317.435	0.039	0.083	0.052
3	AQR Diversified Arbitrage I (ADAIX)	-679.596	-667.710	-624.802	-671.284	-662.168	-619.261	0.047	0.070	0.169
4	iShares Gold Trust (IAU)	-417.207	-382.092	-419.207	-408.895	-376.550	-413.665	0.078	0.094	0.078
5	Bitcoin Market Price USD (^BTC)	-17.637	15.443	-18.210	-9.325	20.985	-12.669	0.071	0.097	0.076
6	AQR Risk-Balanced Commodities Strategy I (ARCIIX)	-382.235	-345.458	-384.209	-373.923	-339.916	-378.668	0.066	0.097	0.067
7	AQR Long-Short Equity I (QLEIX)	-471.236	-448.901	-466.863	-462.924	-443.360	-461.322	0.034	0.059	0.064
8	AQR Style Premia Alternative I (QSPIX)	-444.950	-432.415	-429.054	-436.638	-426.874	-423.513	0.055	0.084	0.134
9	AQR Equity Market Neutral I (QMNXIX)	-503.627	-483.176	-499.914	-495.315	-477.635	-494.372	0.063	0.077	0.101
10	AQR Macro Opportunities I (QGMIX)	-567.909	-544.492	-564.954	-559.597	-538.950	-559.412	0.068	0.067	0.084
11	AGF U.S. Market Neutral Anti-Beta (BTAL)	-406.536	-379.027	-405.510	-398.224	-373.485	-399.969	0.042	0.077	0.060
12	AQR Managed Futures Strategy HV I (QMHIIX)	-379.619	-334.573	-381.619	-371.307	-329.032	-376.078	0.059	0.103	0.059
13	Invesco DB US Dollar Bullish (UUP)	-593.853	-545.432	-595.853	-585.541	-539.890	-590.312	0.054	0.099	0.054
14	ProShares VIX Mid-Term Futures (VIXM)	-270.022	-252.818	-221.081	-261.710	-247.276	-215.539	0.048	0.073	0.140

Box and Whisker Plot



Box and Whisker Plot

