

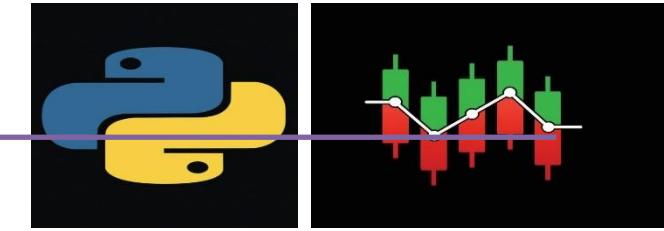


ALGORITHMIC TRADING IN PYTHON

Ganga Singh

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Introduction



SELECTED TICKERS

Grain Futures (Wheat [ZW=F], Corn [ZC=F], Soybean [ZS=F])

Insurance companies (Chubb LTD [CB], The Travelers Companies INC [TRU])

Transportation (³Matsen INC [MATRIX])

Retail/Food (Walmar t [WMT], Bayer AG [BAYER])



Grain Features

- Provides direct exposure to volatile commodity prices essential for food production

Transportation

- Ensures the efficient flow of grains from producers to markets

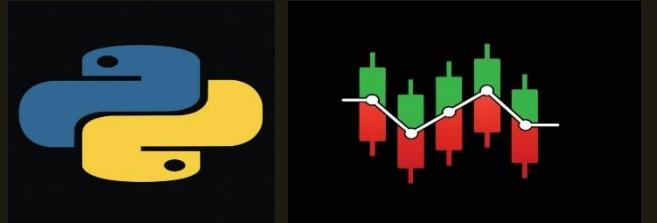
Insurance companies

- Mitigate risks associated with grain transportation, protecting the supply chain from disruptions

Retail/Food

- Walmart distributes food to consumers, Bayer supplies agricultural inputs, completing the supply chain

Trading Strategy Overview



Strategic Rationale

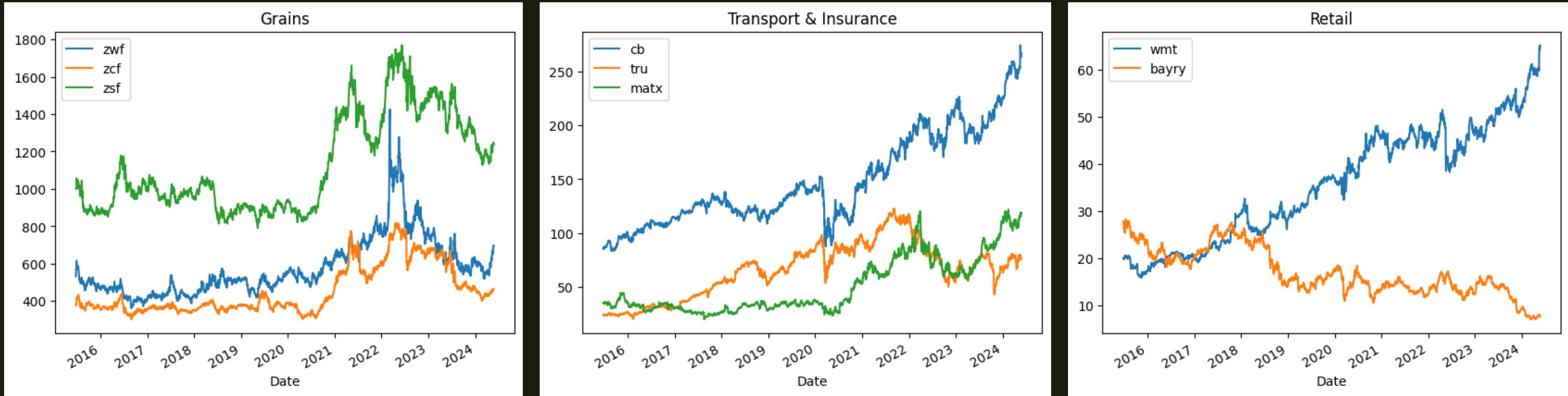
- **Vertical Integration:** The selected tickers represent a fully integrated supply chain, from grain production to retail, ensuring comprehensive coverage and risk mitigation
- **Essential Commodities:** Grains are vital for global food production. The period from 2020 to 2024 includes significant disruptions from the pandemic and the Russia-Ukraine crisis, highlighting their critical role

Contextual Background



- **Pandemic and Geopolitical Shocks:** The COVID-19 pandemic and Russia-Ukraine crisis caused major supply chain disruptions, emphasizing the importance of reliable grain supplies
- **Supply Chain Resilience:** Investing across the supply chain enhances risk management and potential returns by covering different stages
- **Less Popular Strategy:** Unlike common strategies involving S&P 500 or IT stocks, this approach focuses on essential commodities and supply chain resilience, offering a unique investment perspective

Asset Price Evolution



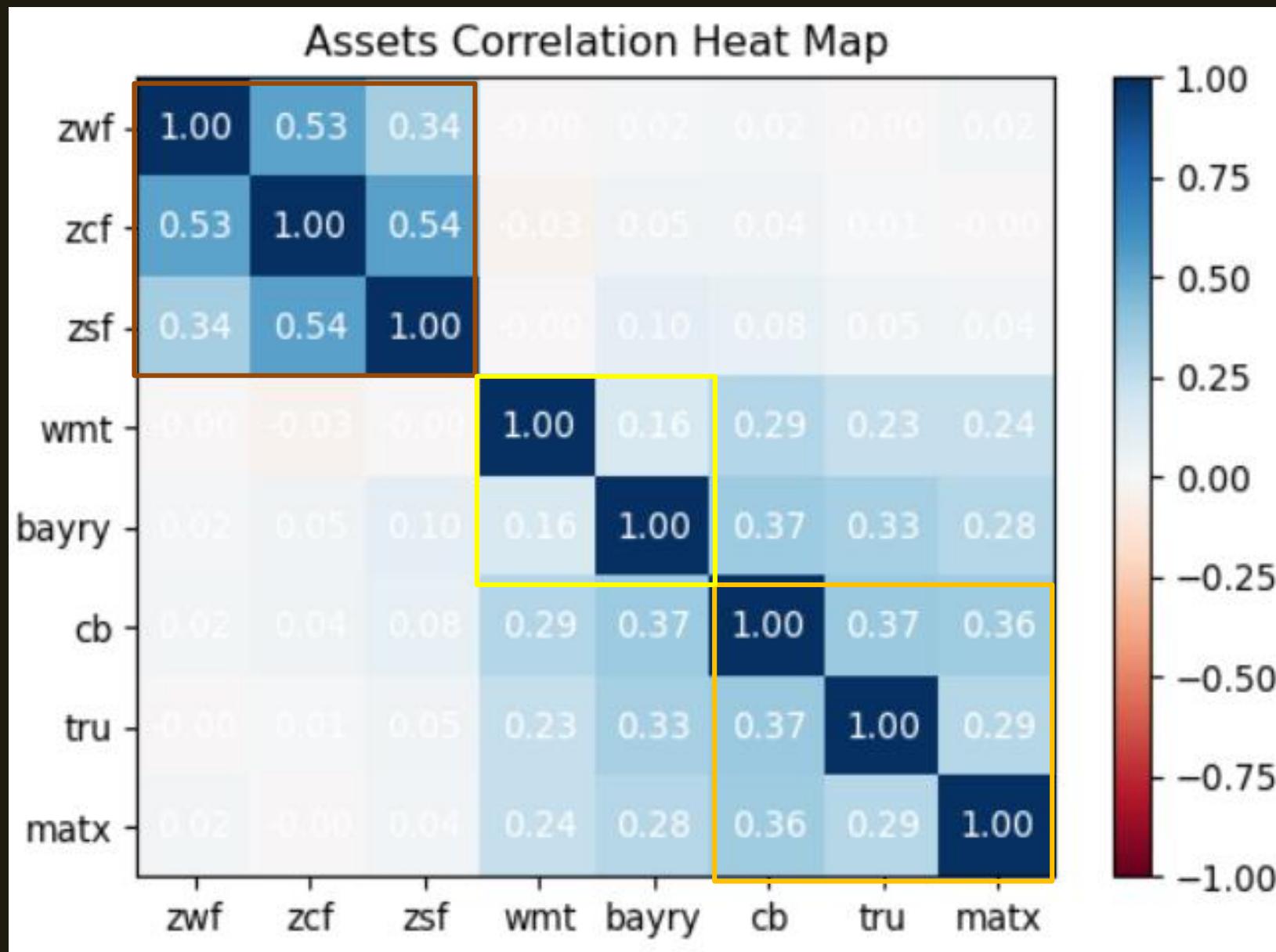
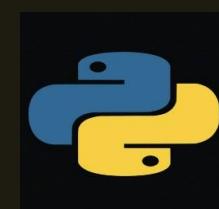
SOYBEAN FUTURES (ZS=F): Significant volatility with peaks around 2021 and 2023

WHEAT FUTURES & CORN FUTURES (ZW=F, ZC=F): Similar, less dramatic patterns

INSURANCE COMPANIES (CB, TRU): Steady growth, indicating sector stability amidst economic fluctuations

RETAIL AND AGRICULTURAL INPUTS (WMT, BAYRY): Relatively stable trends

Descriptive Analytics



Stat	zwf	zcf	zsf	wmt	bayry	cb	tru	matx
Start	2015-06-25	2015-06-25	2015-06-25	2015-06-25	2015-06-25	2015-06-25	2015-06-25	2015-06-25
End	2024-05-22	2024-05-22	2024-05-22	2024-05-22	2024-05-22	2024-05-22	2024-05-22	2024-05-22
Risk-free rate	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Total Return	31.16%	22.44%	24.22%	227.44%	-72.22%	213.24%	212.86%	233.02%
Daily Sharpe	0.25	0.22	0.22	0.73	-0.33	0.65	0.56	0.53
Daily Sortino	0.47	0.34	0.36	1.18	-0.49	1.04	0.89	0.90
CAGR	3.09%	2.30%	2.46%	14.24%	-13.39%	13.67%	13.66%	14.46%
Max Drawdown	-63.55%	-51.15%	-36.22%	-25.74%	-75.40%	-42.59%	-64.92%	-55.18%
Calmar Ratio	0.05	0.04	0.07	0.55	-0.18	0.32	0.21	0.26

Chubb LTD & Matson INC:
Robust performance with low-risk

GRAIN FUTURES CORRELATION:
Strong Correlation (~0.53 to 0.54)

RETAIL AND FOOD STOCKS CORRELATION:
Lower Correlation (~0.16 to 0.29)

INSURANCE STOCKS CORRELATION:
Moderate Correlation (~0.37)

Grain Futures:
Potential high rewards

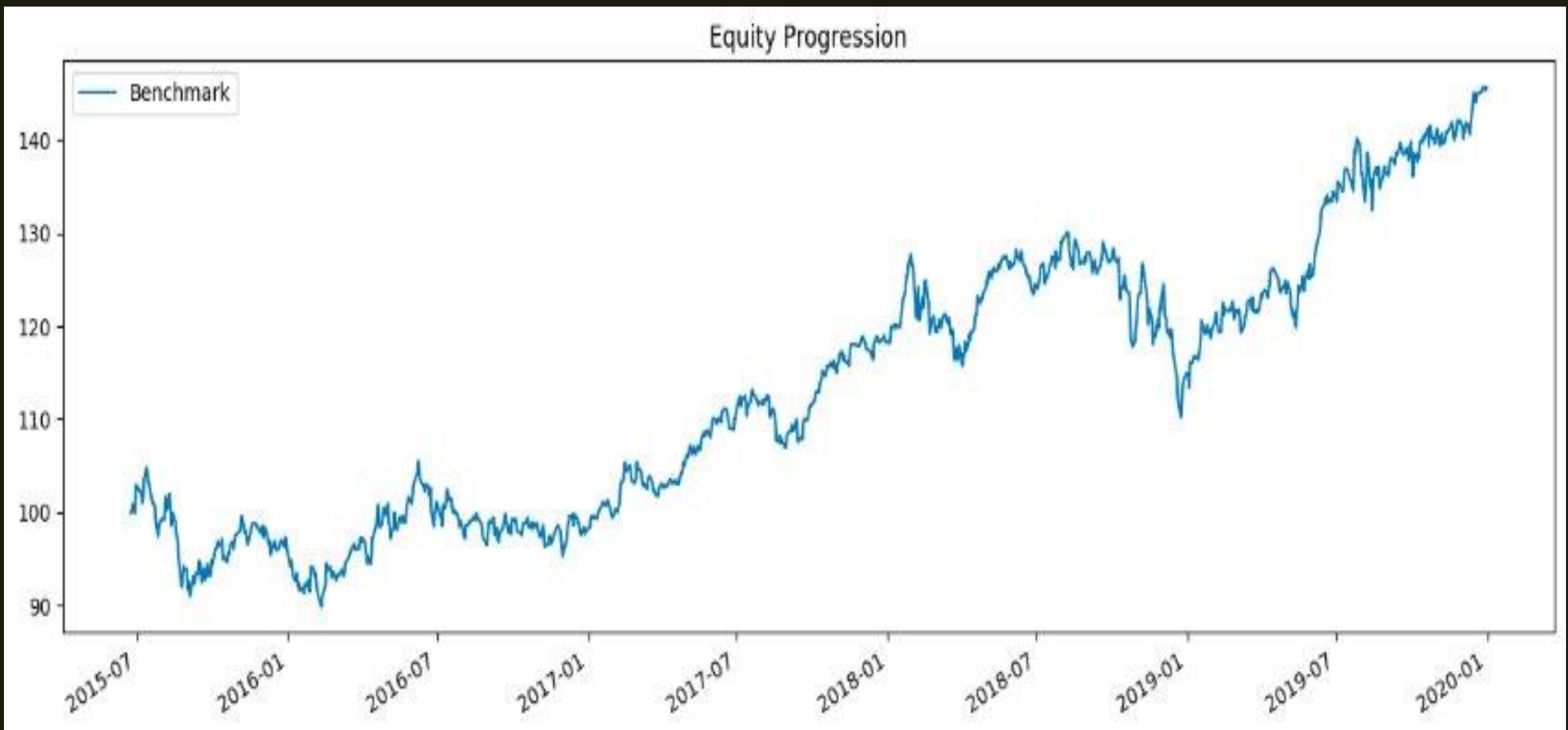
Walmart & Bayer AG:
Stable returns and moderate growth

B e n c h m a r k



Description:

“Buy-and-hold Strategy” that invests equally in all available instruments and periodically rebalances the portfolio to maintain equal weights.

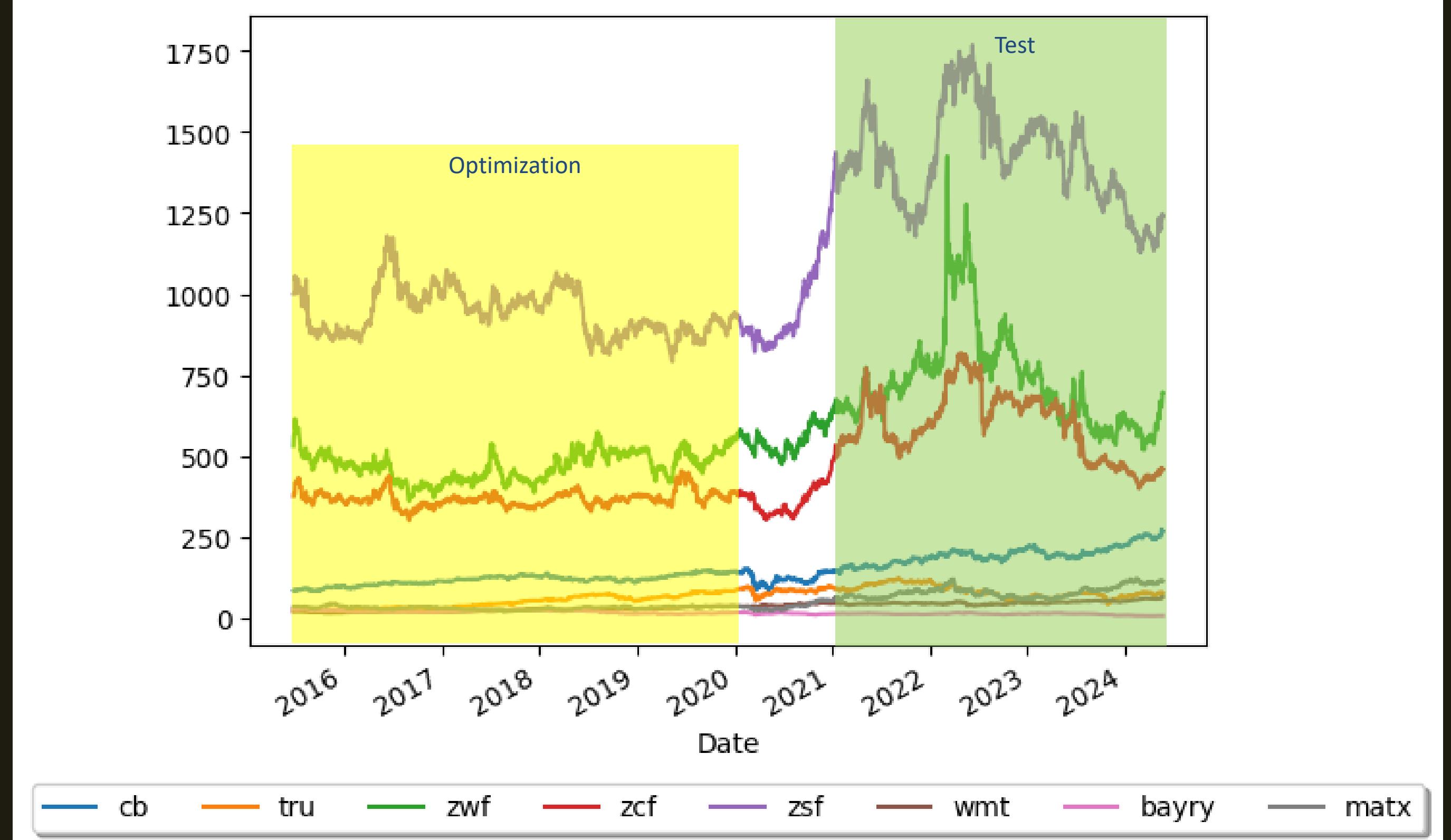


Metric	Benchmark
Total Return	45.60%
Daily Sharpe	0.73
Daily Sortino	1.21
CAGR	8.67%
Max Drawdown	-15.28%
Calmar Ratio	0.57

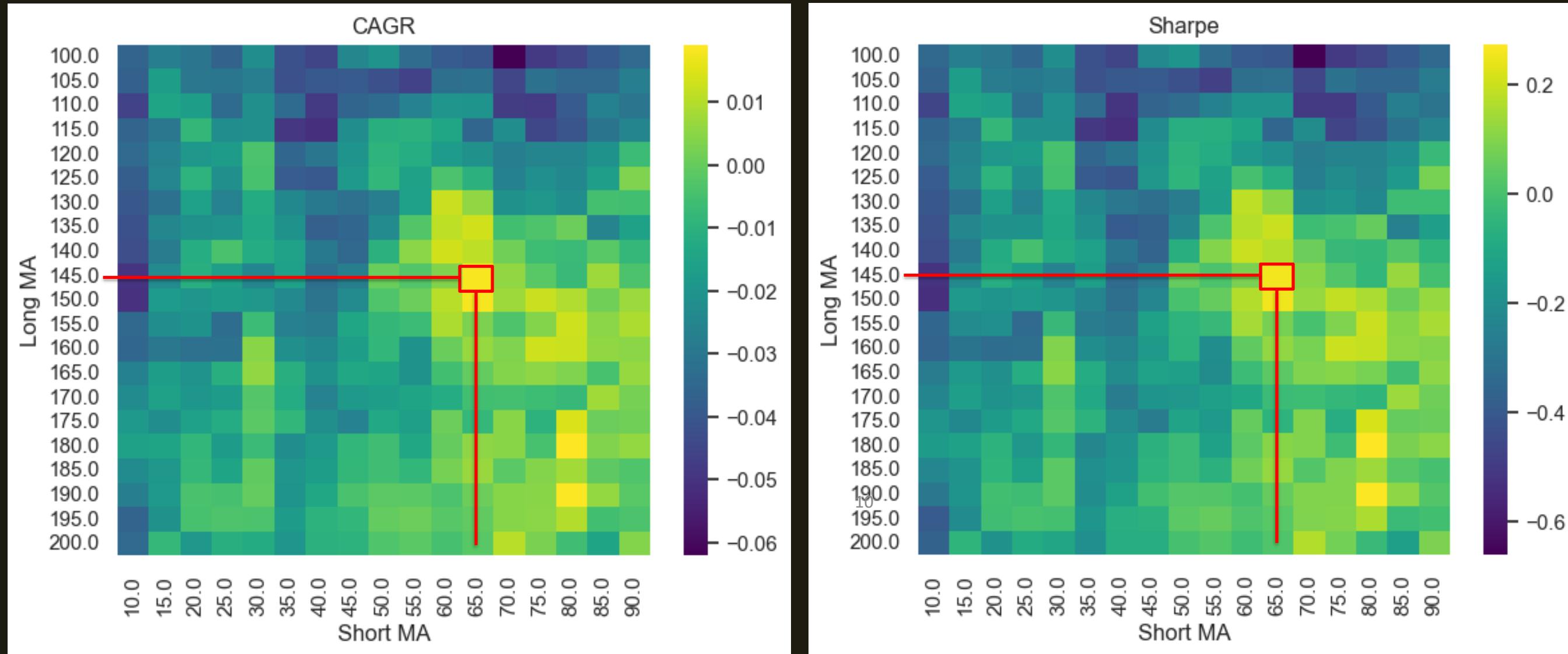
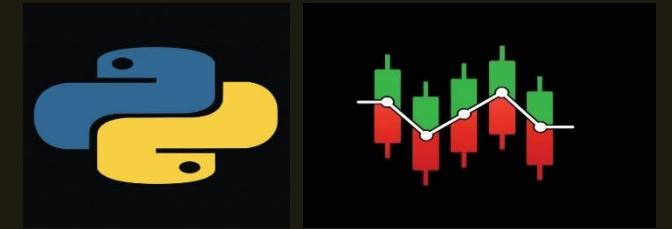
Optimized Strategies and Test



- Simple Moving Average
- Exponential Moving Average
- Mean-Variance Optimization
- Momentum and Volatility
- Relative Strength Index (RSI)

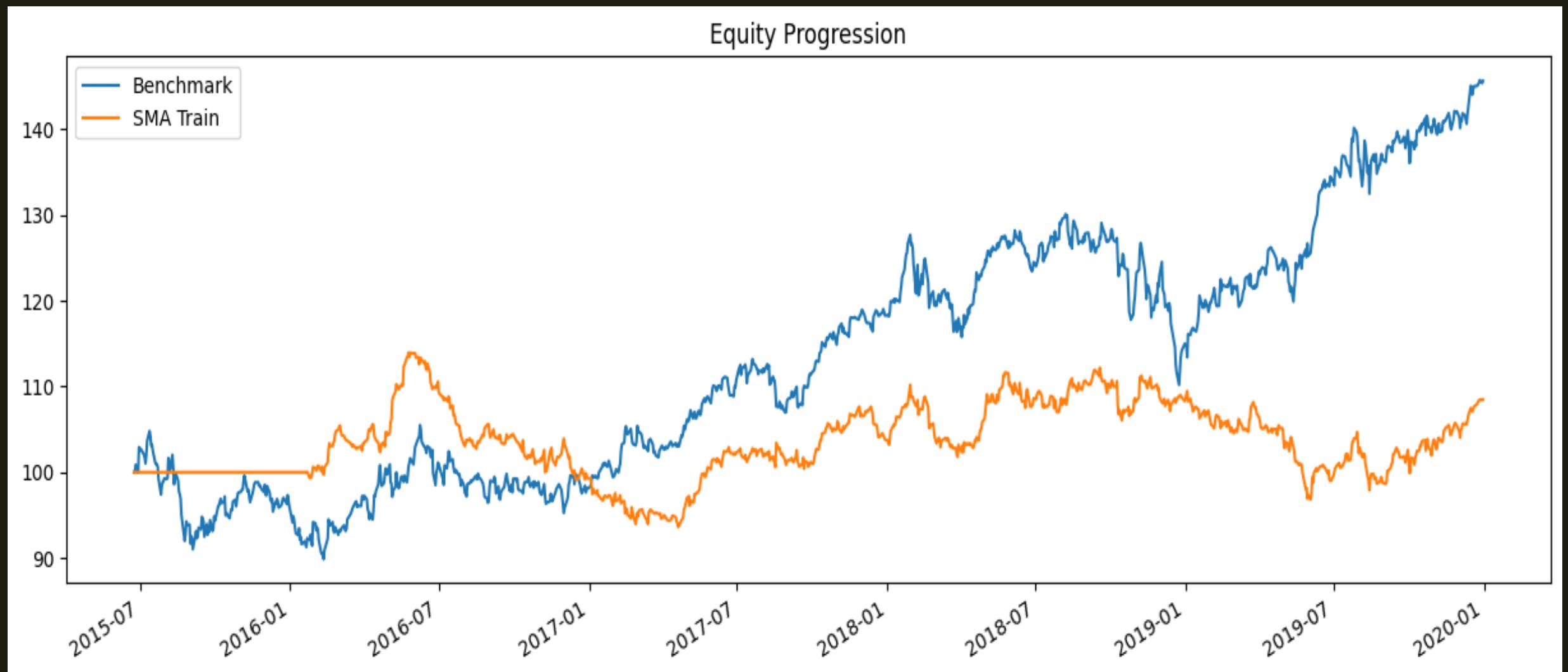


Strategy 1 – Simple Moving Average



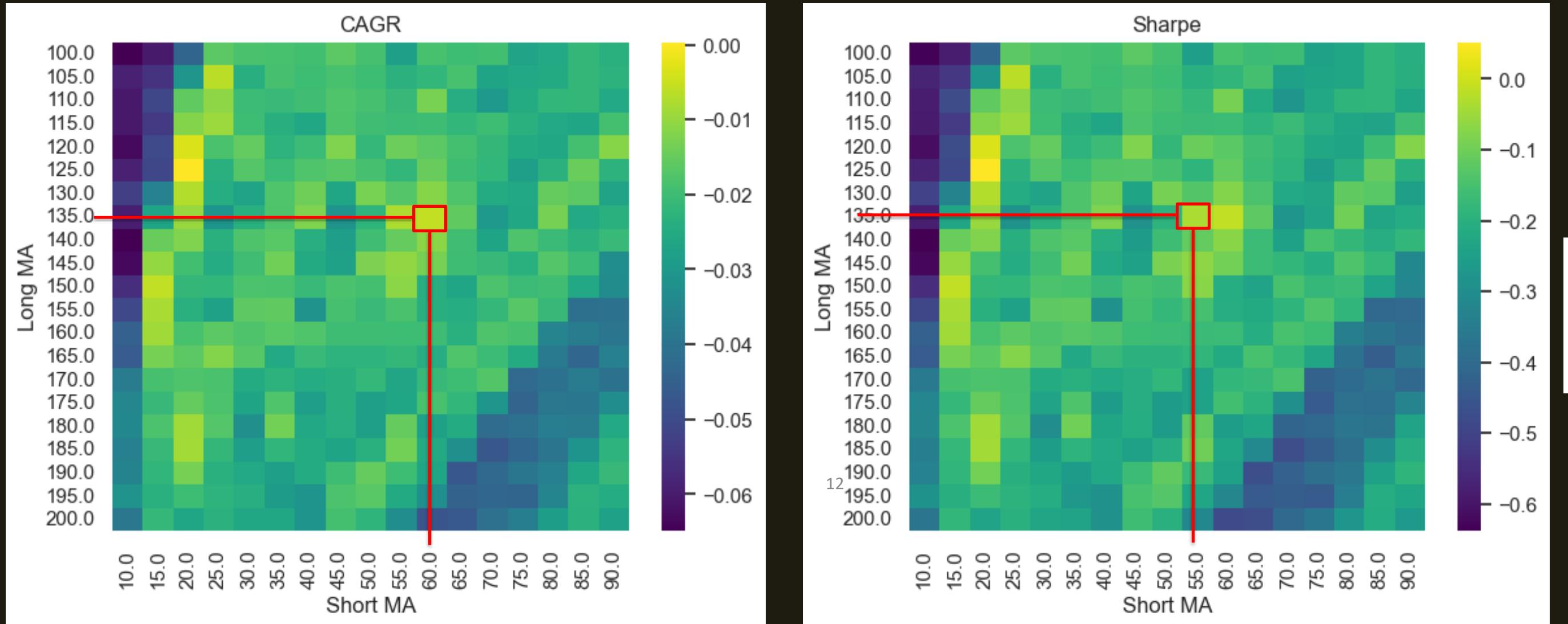
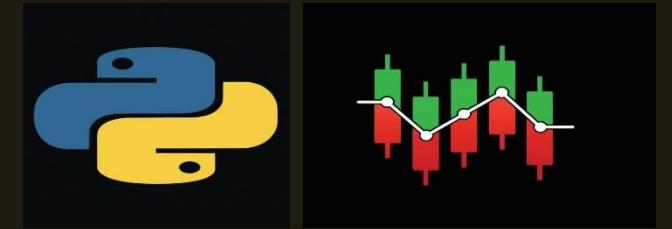
Optimized Days
Short: 65
Long: 145

Strategy 1 – Simple Moving Average



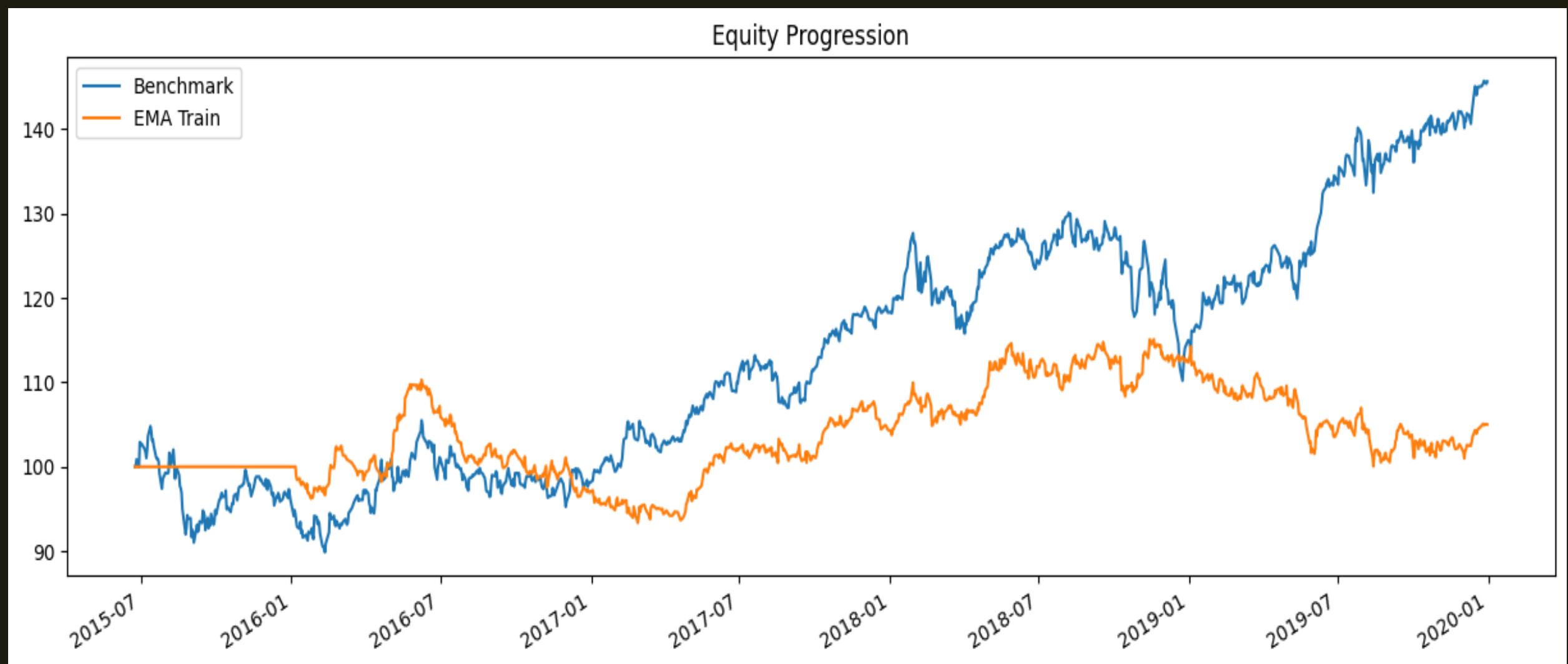
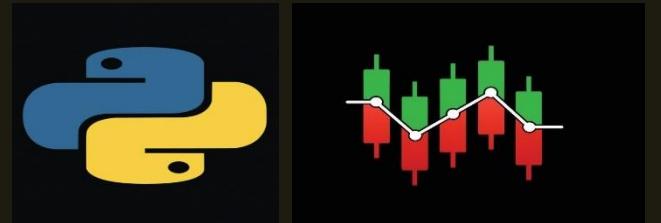
	SMA	Bench
<i>Total Return</i>	8.48%	49.29%
<i>Daily Sharpe</i>	0.26	0.73
<i>Daily Sortino</i>	0.42	1.21
<i>CAGR</i>	1.88%	8.61%
<i>Max Drawdown</i>	-17.83%	-15.32%
<i>Calmar Ratio</i>	0.10	0.56

Strategy 2 – Exponential Moving Average



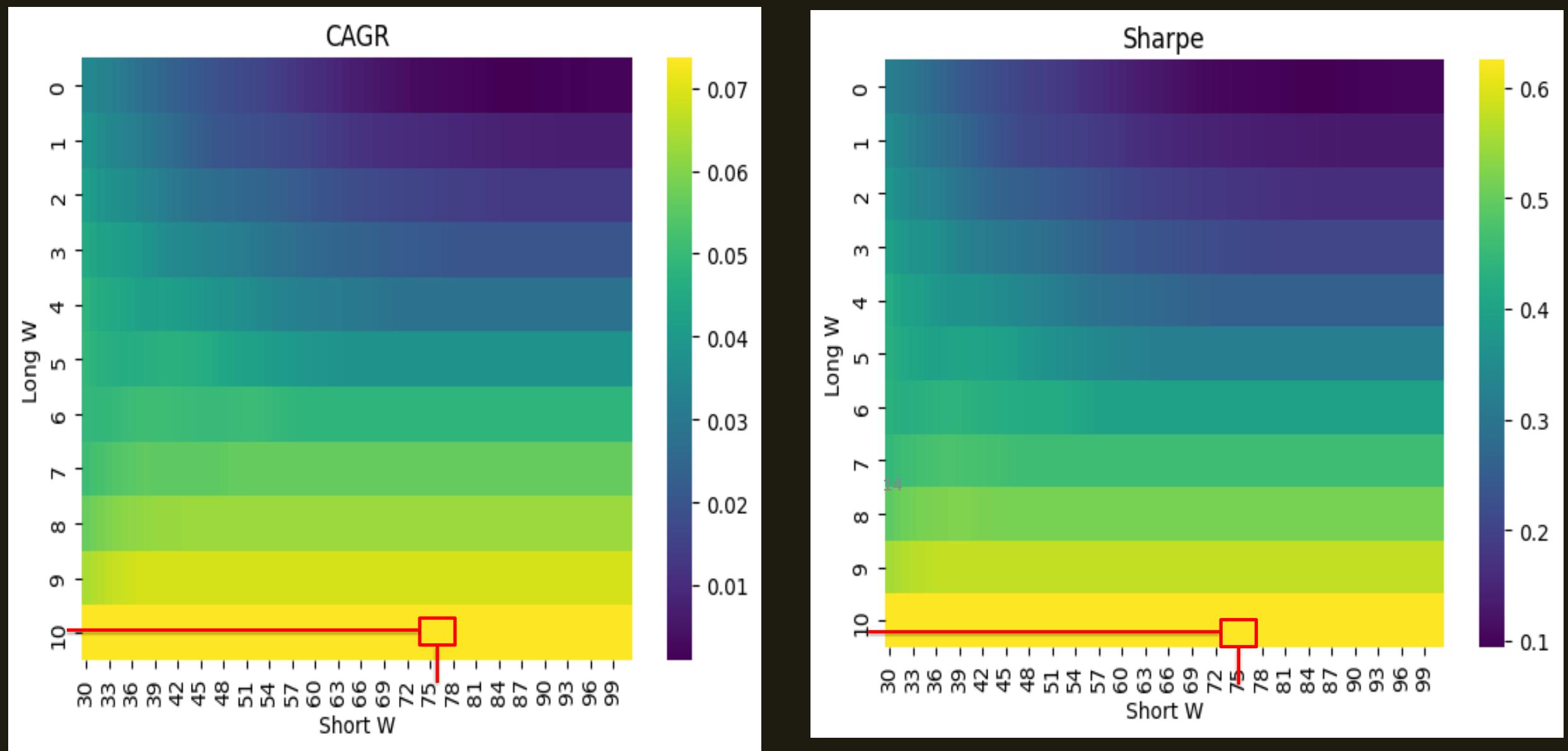
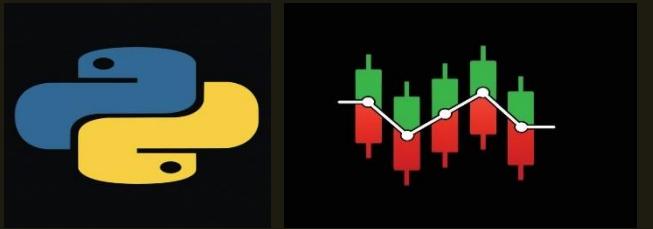
Optimized Days
Short: 60
Long: 135

Strategy 2 – Exponential Moving Average

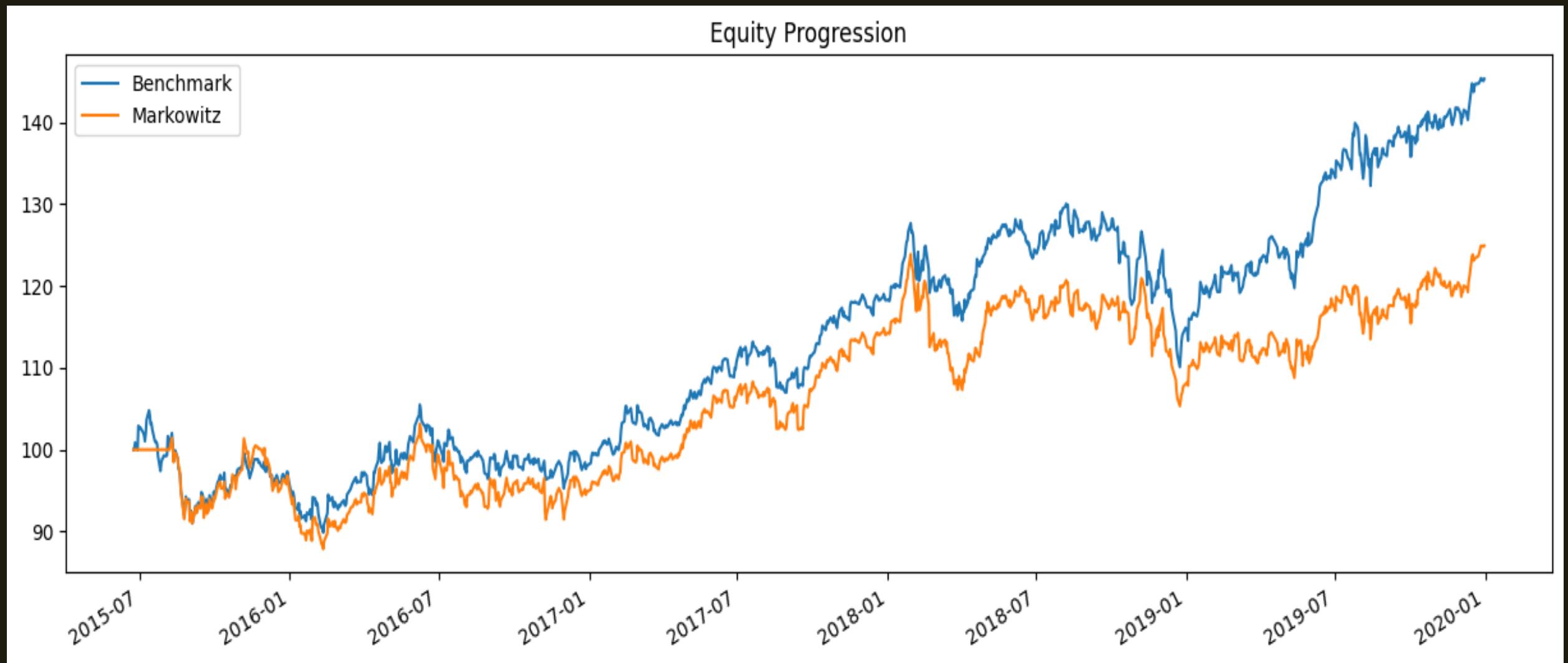


	EMA	Bench
Total Return	5.01%	49.29%
Daily Sharpe	0.17	0.73
Daily Sortino	0.28	1.21
CAGR	1.09%	8.61%
Max Drawdown	-15.36%	-15.32%
Calmar Ratio	0.07	0.56

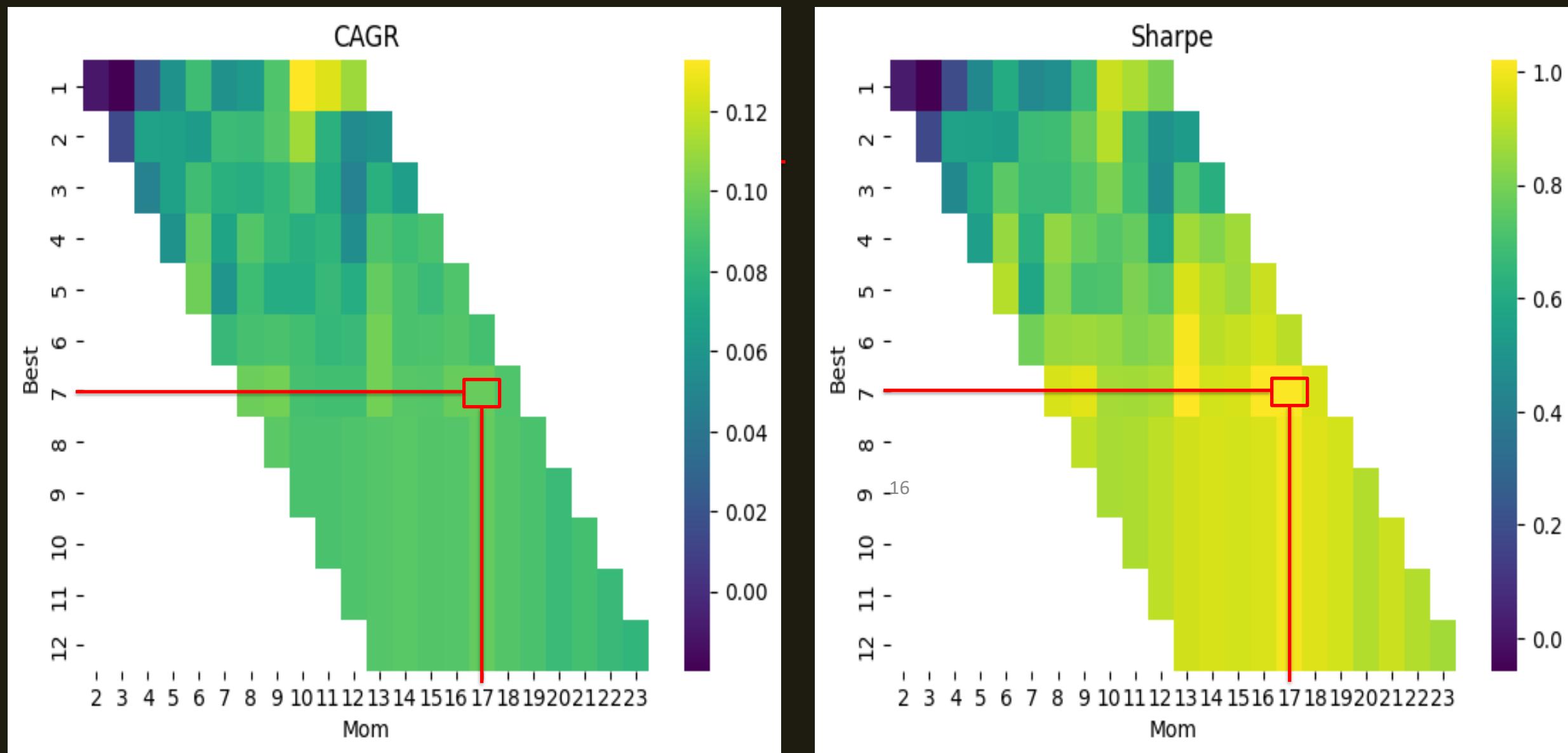
Strategy 3 – Mean-Variance Optimization



Strategy 3 – Mean-Variance Optimization

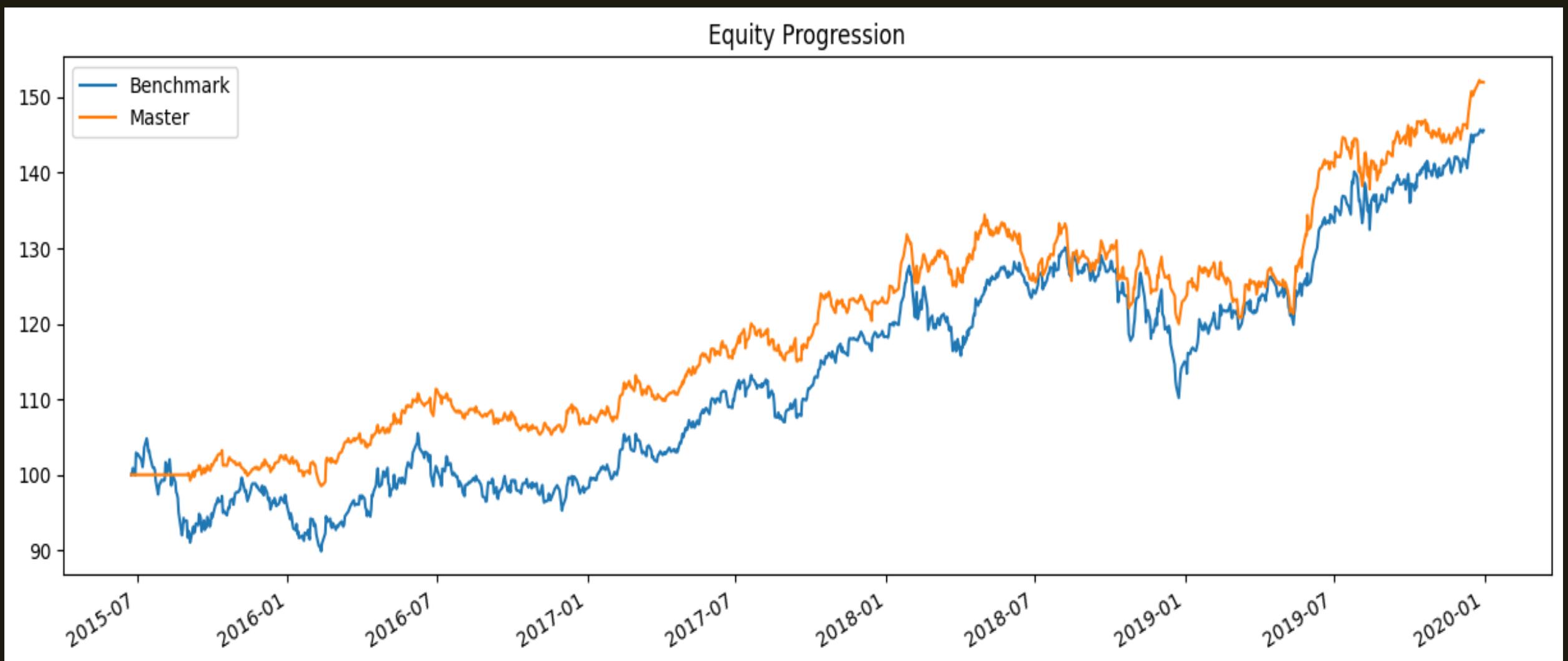


Strategy 4 – Combined Momentum and Volatility

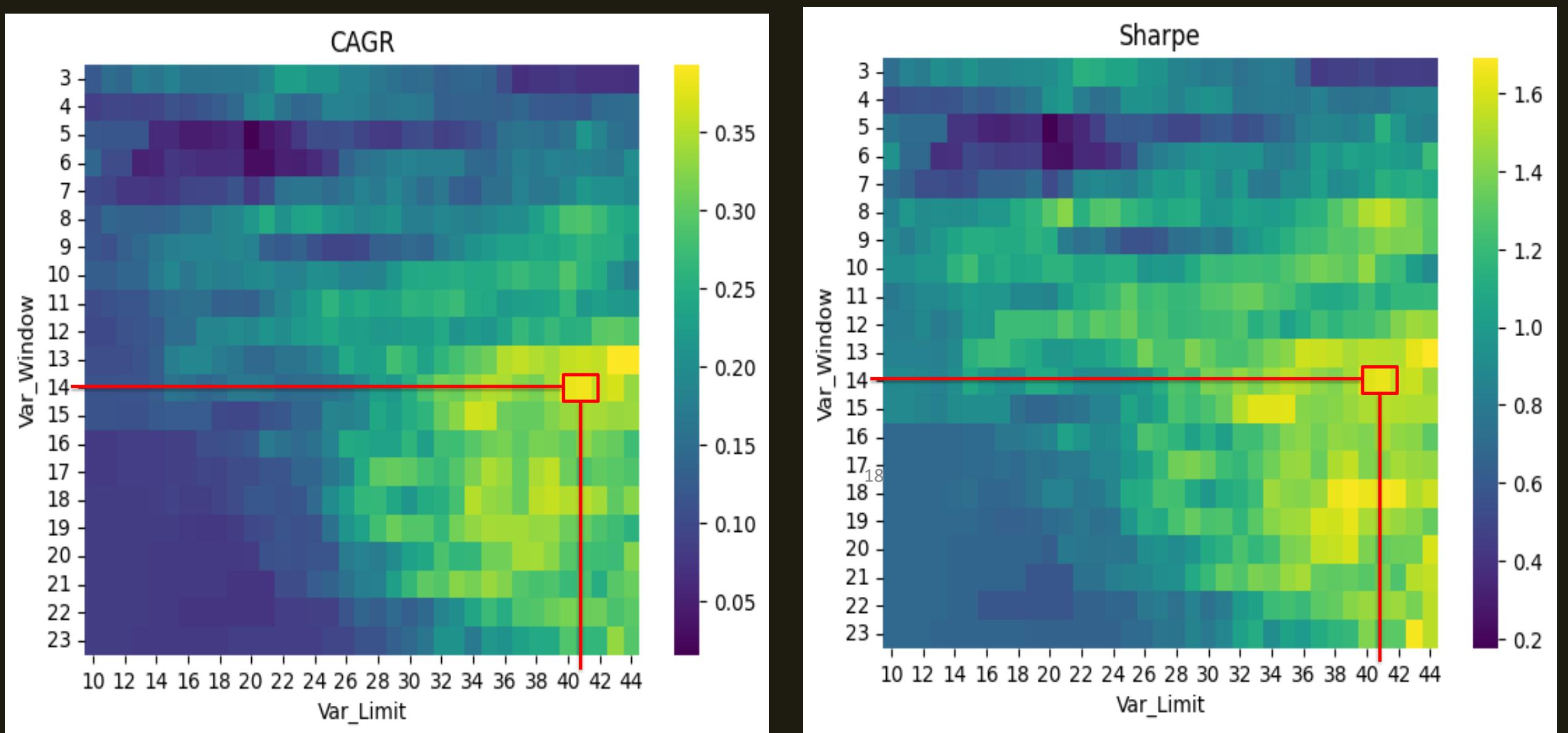
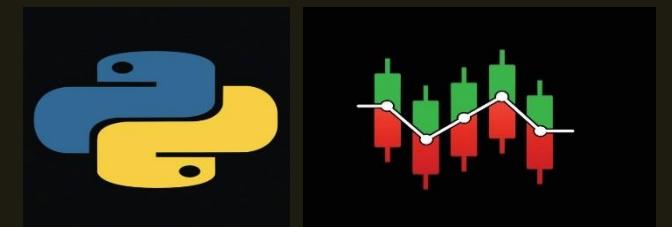


Optimized Parameters
Best: 7
Window: 17

Strategy 4 – Combined Momentum and Volatility

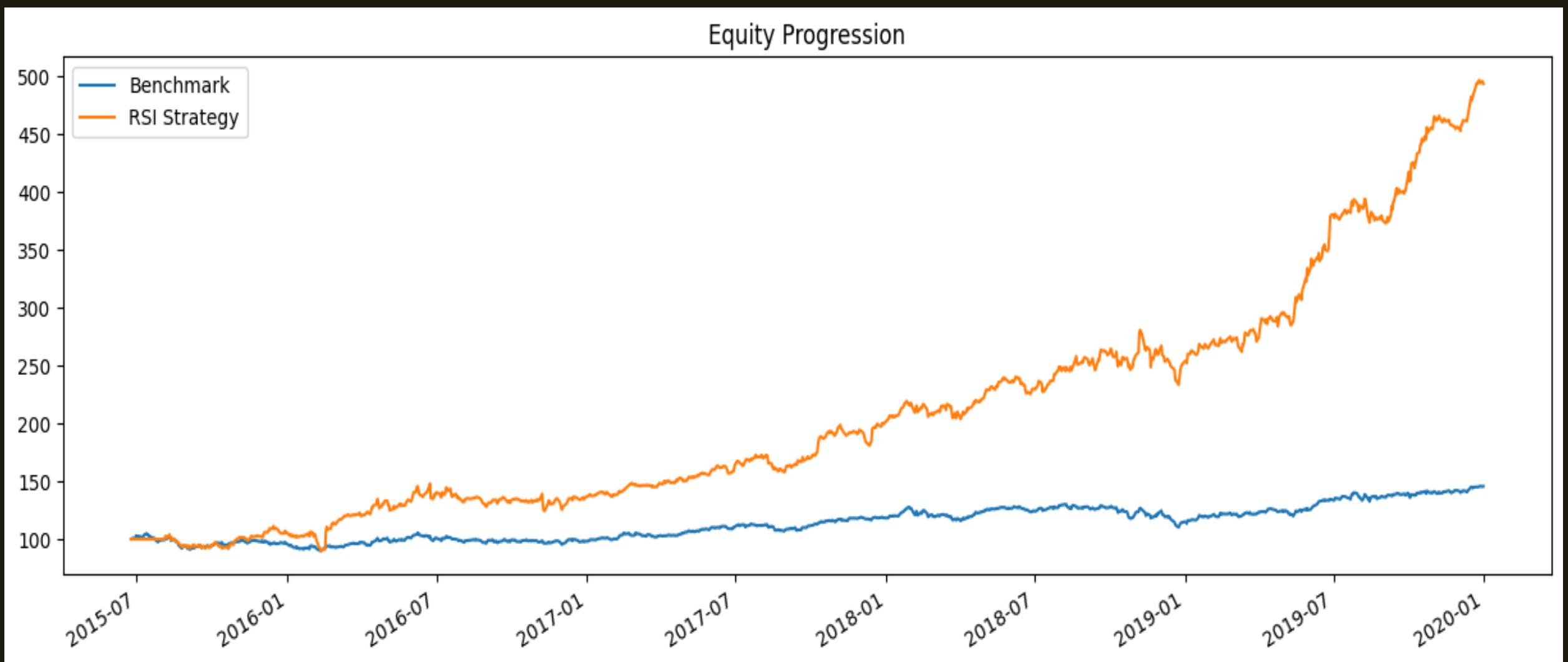
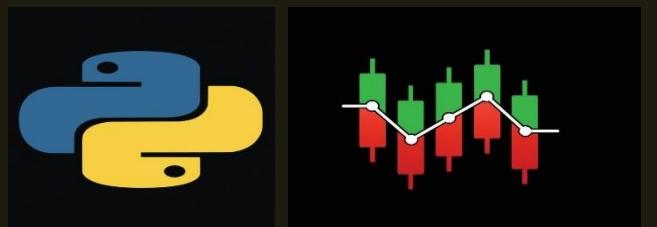


Strategy 5 - RSI



Optimized Parameters
Window: 14
Low: 41
High: 59

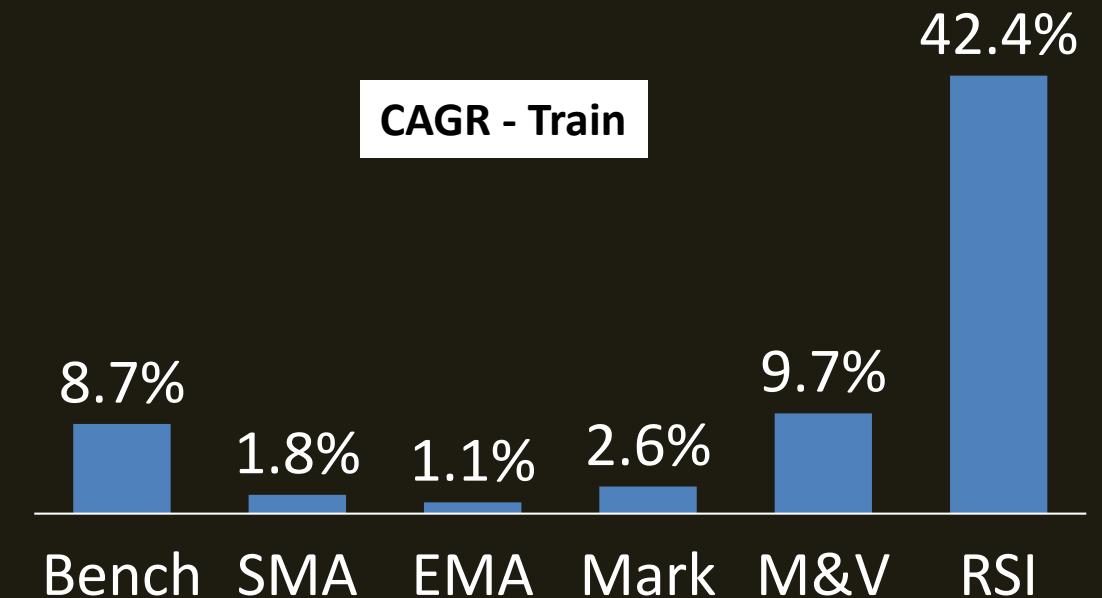
Strategy 5 - RSI



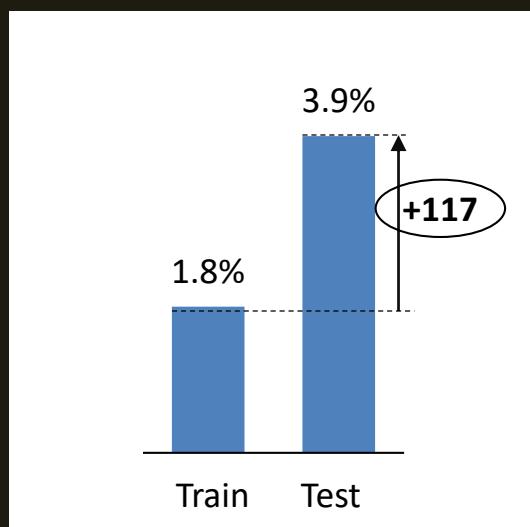
Overfitting Analysis



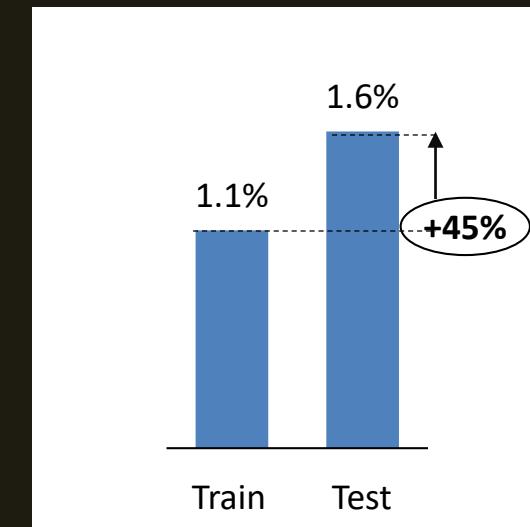
	Bench	SMA		EMA		Mark		Momentum		RSI	
		Train	Test	Train	Test	Train	Test	Train	Test	Train	Test
CAGR	8.7%	1.8%	3.9%	1.1%	1.6%	2.6%	-5.6%	9.7%	-3.2%	42.3%	-2.4%
Daily Sharpe	0.73	0.26	0.41	0.17	0.20	0.24	-0.25	1.01	-0.33	1.76	0.03
Daily Sortino	1.21	0.42	0.68	0.28	0.33	0.37	-0.37	1.69	-0.50	3.20	0.05



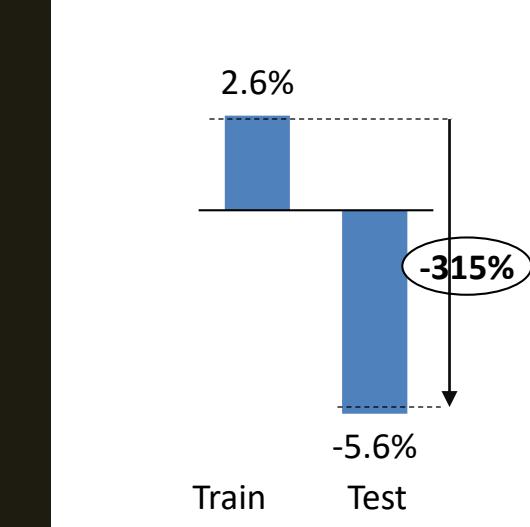
CAGR: SMA



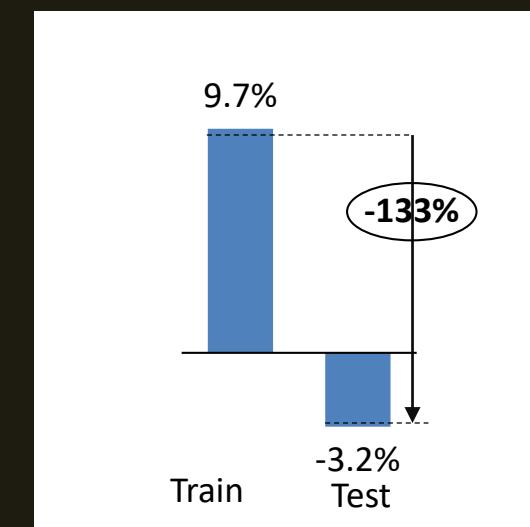
CAGR: EMA



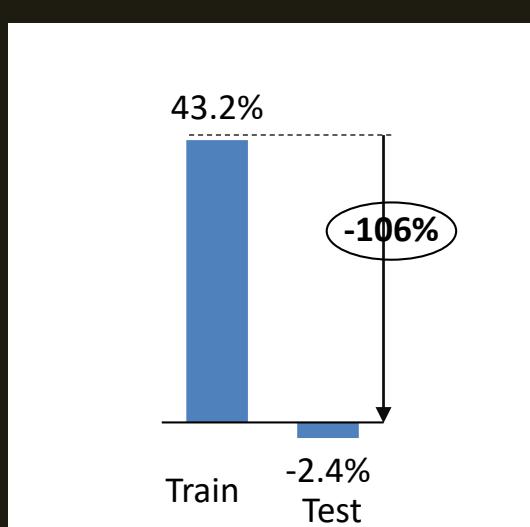
CAGR: Mark



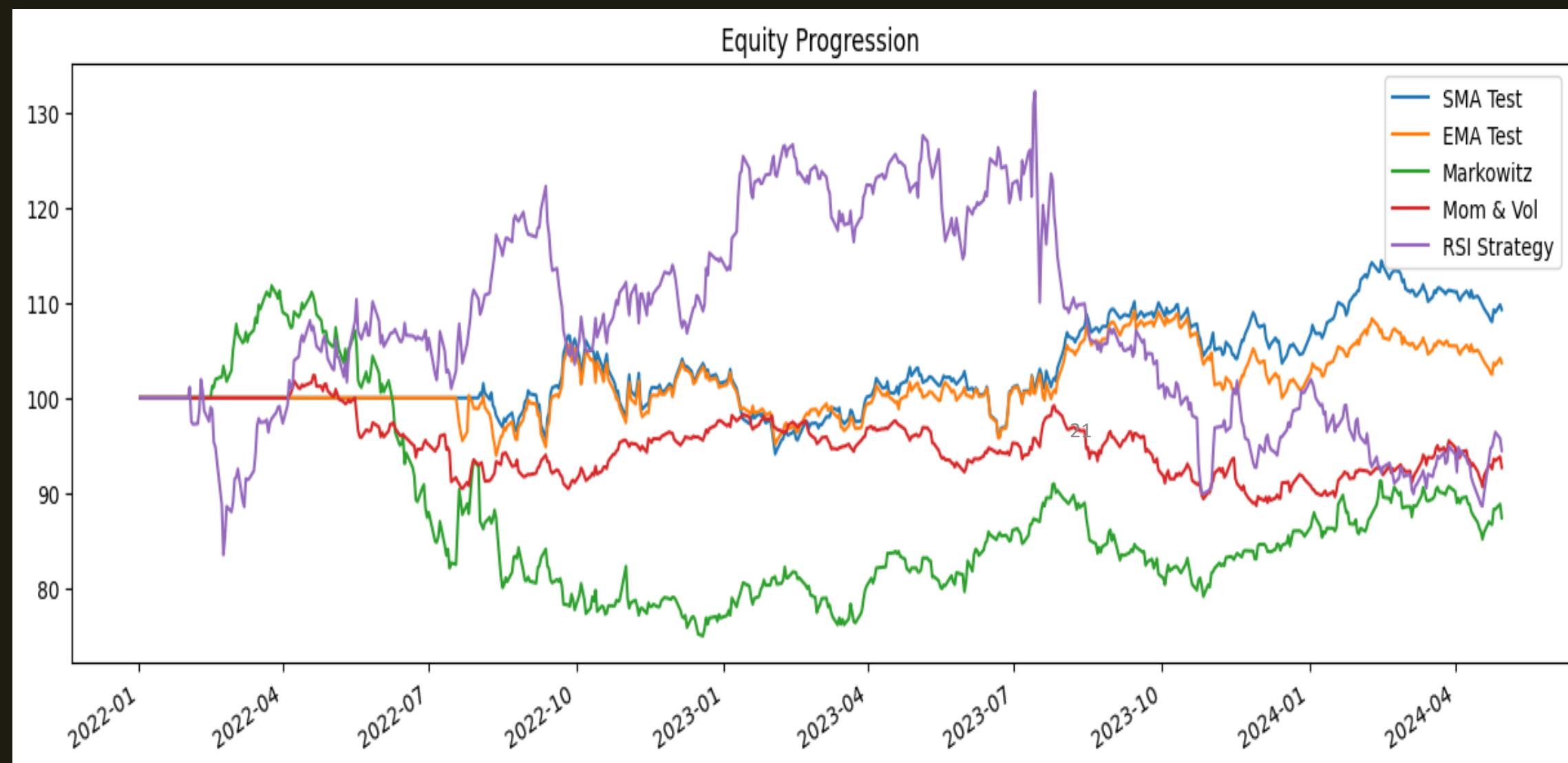
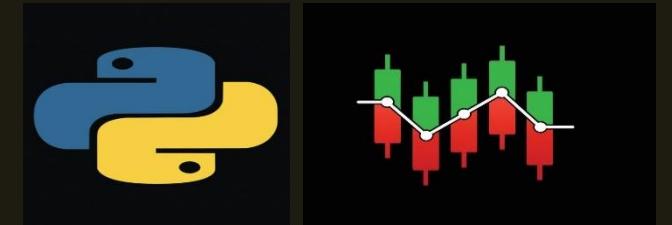
CAGR: Moment



CAGR: RSI

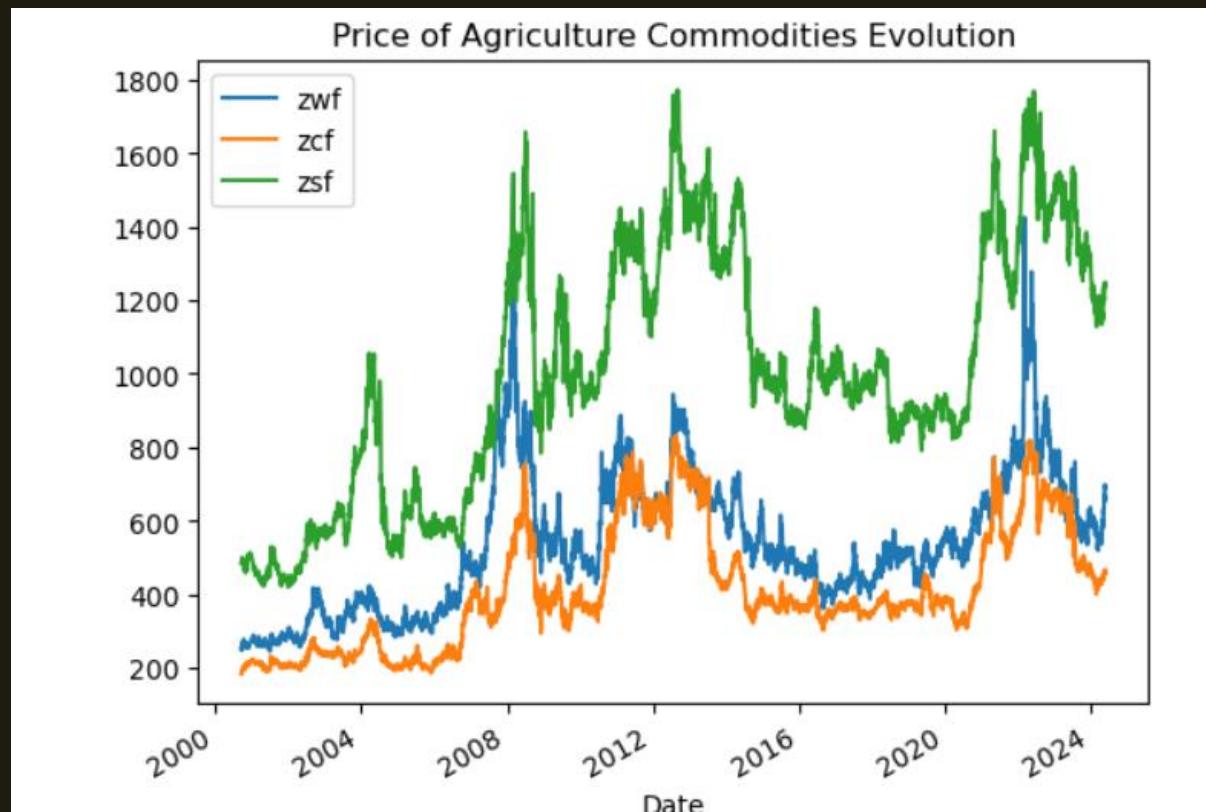
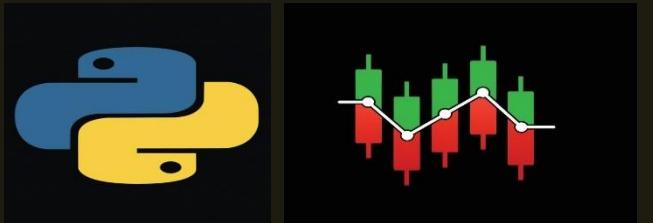


Optimized Strategies Comparison - Test



	SMA	EMA	MVO	M&V	RSI
Total Return	9.38%	3.69%	-12.59%	-7.31%	-5.52%
Daily Sharpe	0.41	0.2	-0.25	-0.33	0.03
Daily Sortino	0.68	0.33	-0.37	-0.50	0.05
CAGR	3.89%	1.57%	-5.62%	-3.21%	-2.41%
Max Drawdown	-11.68%	-9.88%	-32.91%	-13.36%	-32.95%
Calmar Ratio	0.33	0.16	-0.17	-0.24	-0.07

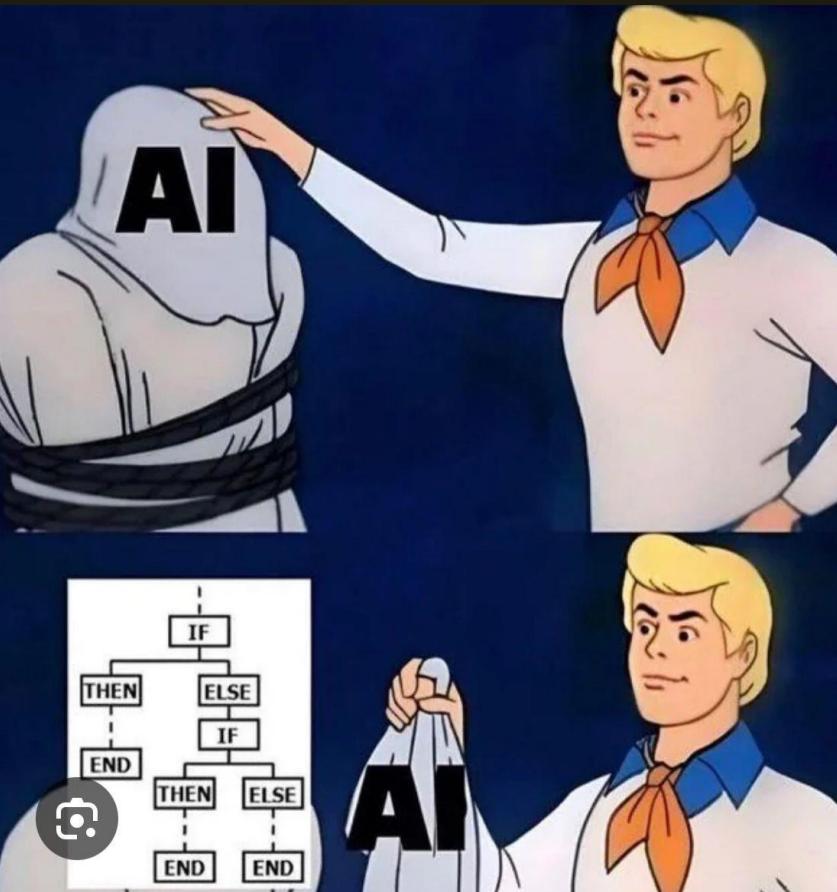
Price of Grains – Regression Tree Model



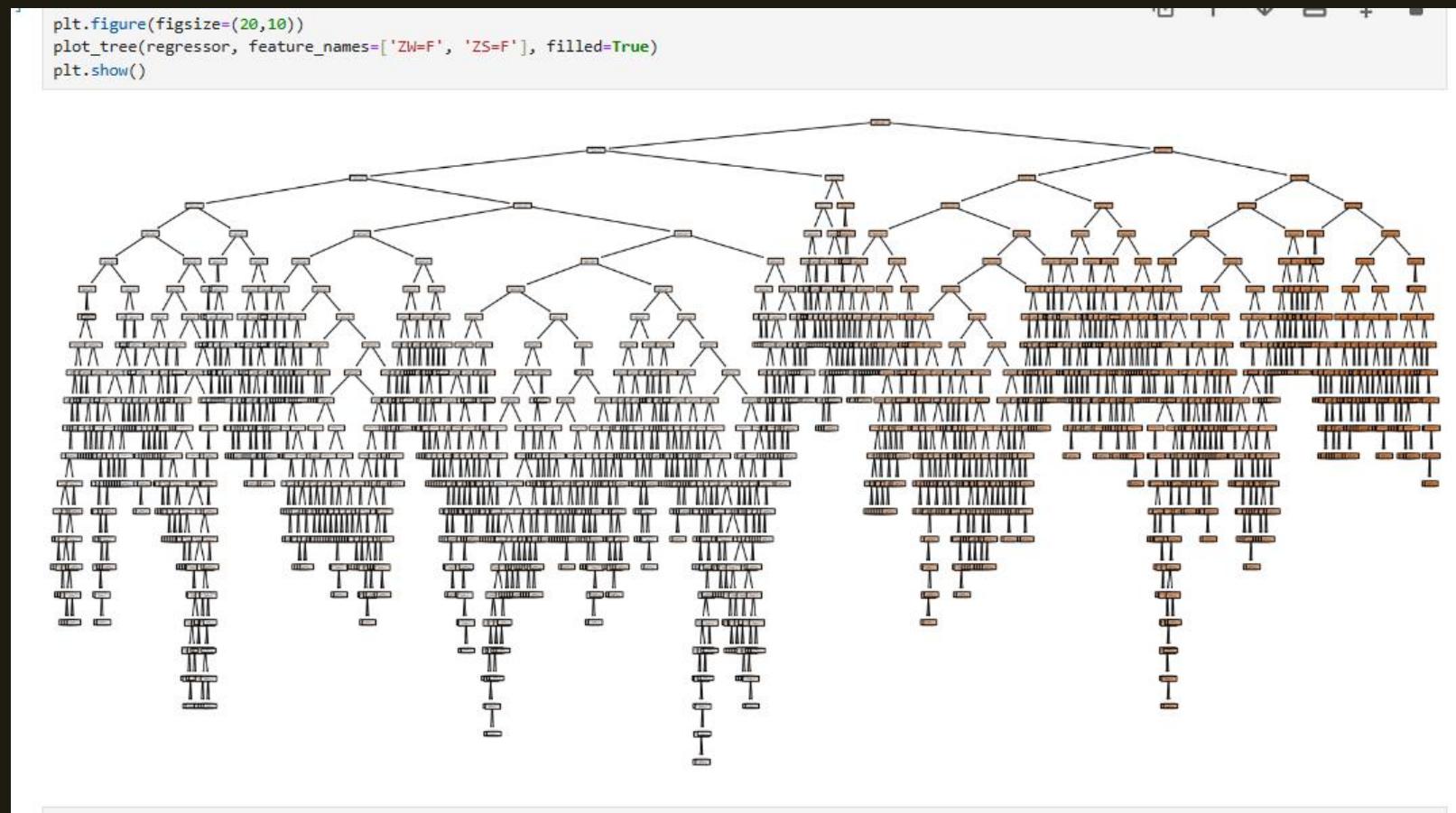
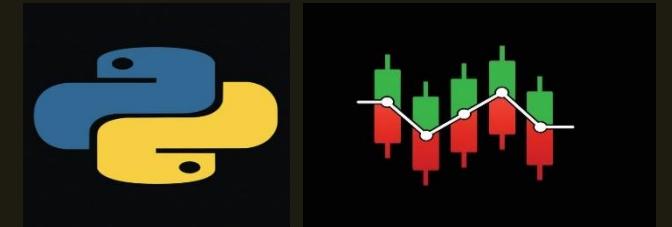
Y= Price of Corn (ZC)

Features = Price of Wheat (ZW) and Soybean (ZS).

The prices of agricultural commodities are influenced by factors like supply and demand dynamics, weather conditions, global economic trends, government policies, and market speculation.



Price of Grains – Regression Tree Model



```
plt.figure(figsize=(20,10))
plot_tree(regressor, feature_names=['ZW=F', 'ZS=F'], filled=True)
plt.show()
```

Accuracy - Training: 1.00
Accuracy - Testing: 0.52

Accuracy - Training: 1.00 = Every prediction made on the training set is correct.

Accuracy - Testing: 0.52: This indicates that the model predicts correctly 52% of the time on the test data.

R e s u l t s a n d C o n c l u s i o n



#2]:	Strategy	CAGR	Sharpe	Sortino
	SMA	3.90	0.41	0.68
	EMA	1.60	0.20	0.33
	Markowitz	-5.60	-0.25	-0.37
	Momentum	-3.20	-0.33	-0.50
	RSI	-2.40	0.03	0.05
	Benchmark	8.67	0.73	1.21

- The benchmark is the best performer in terms of return.
- Then SMA and EMA strategies, have the best performance.
- Markowitz and Momentum strategies have particularly poor performance.
- **Sometimes Less is more.**

THANK YOU



Q & A

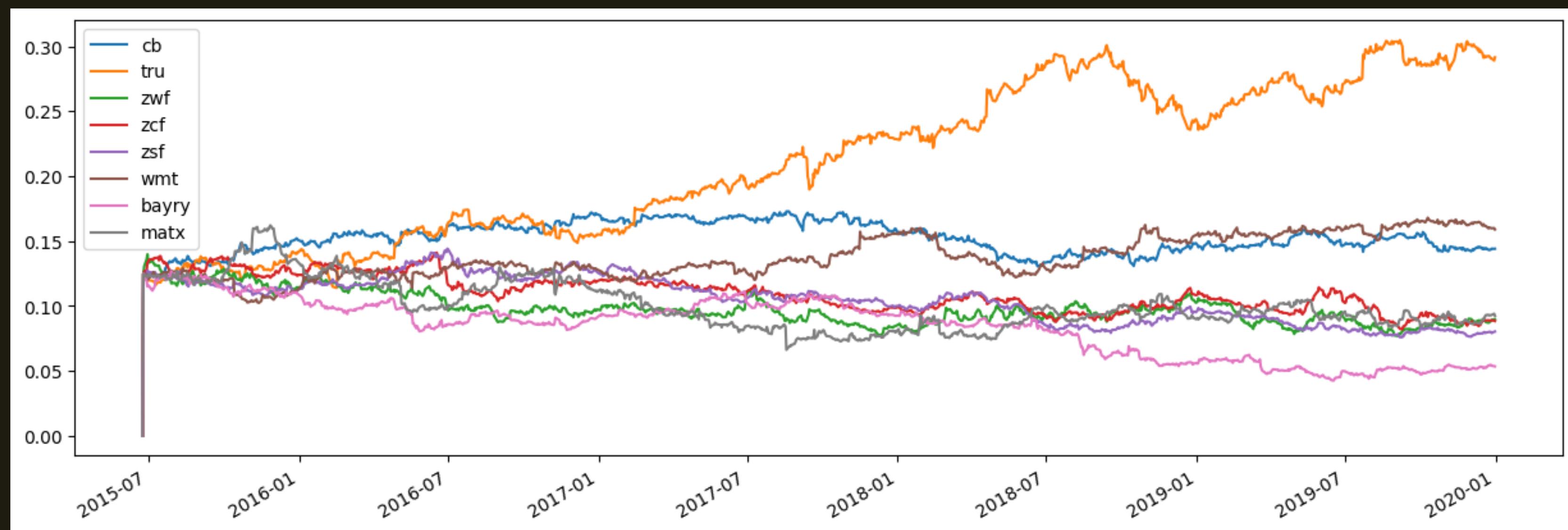
People with no idea about AI
saying it will take over the world:



My Neural Network:

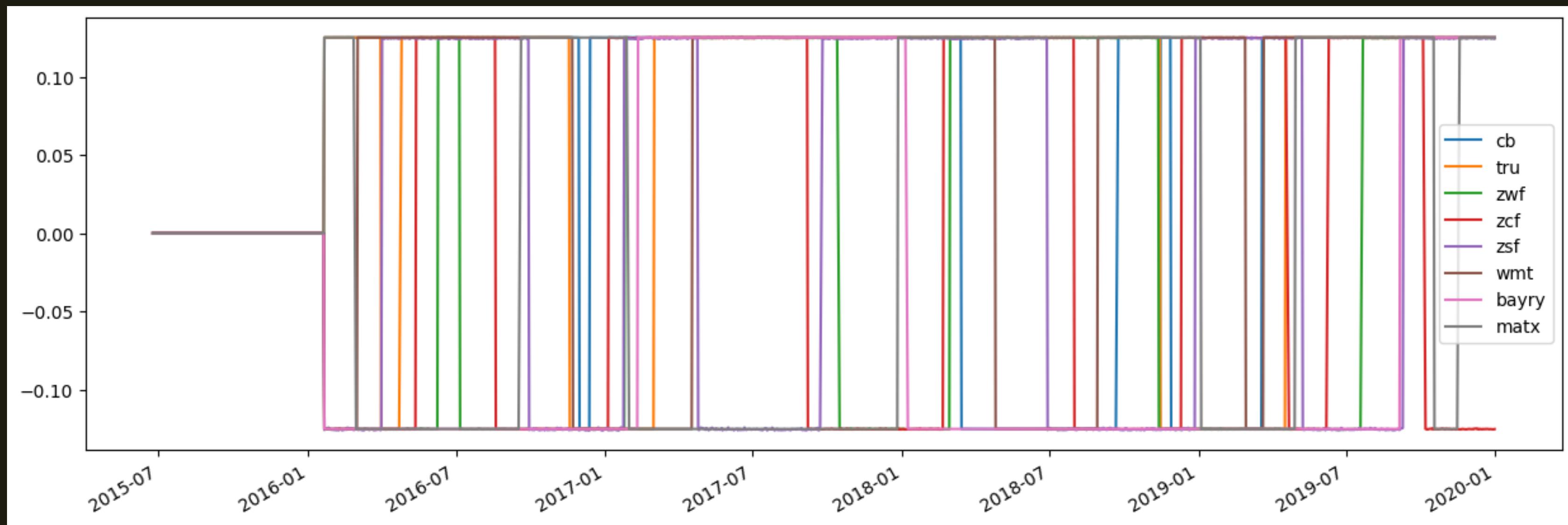
Appendix

Weight distribution - Benchmark



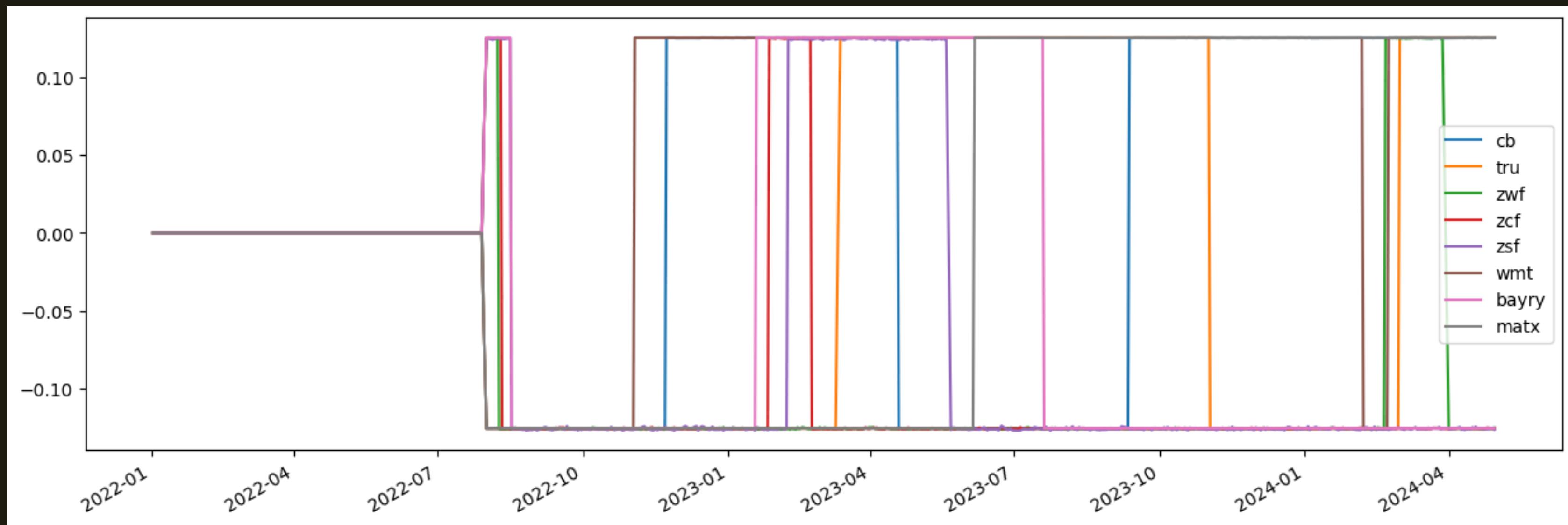
Appendix

Weight distribution – SMA - Train



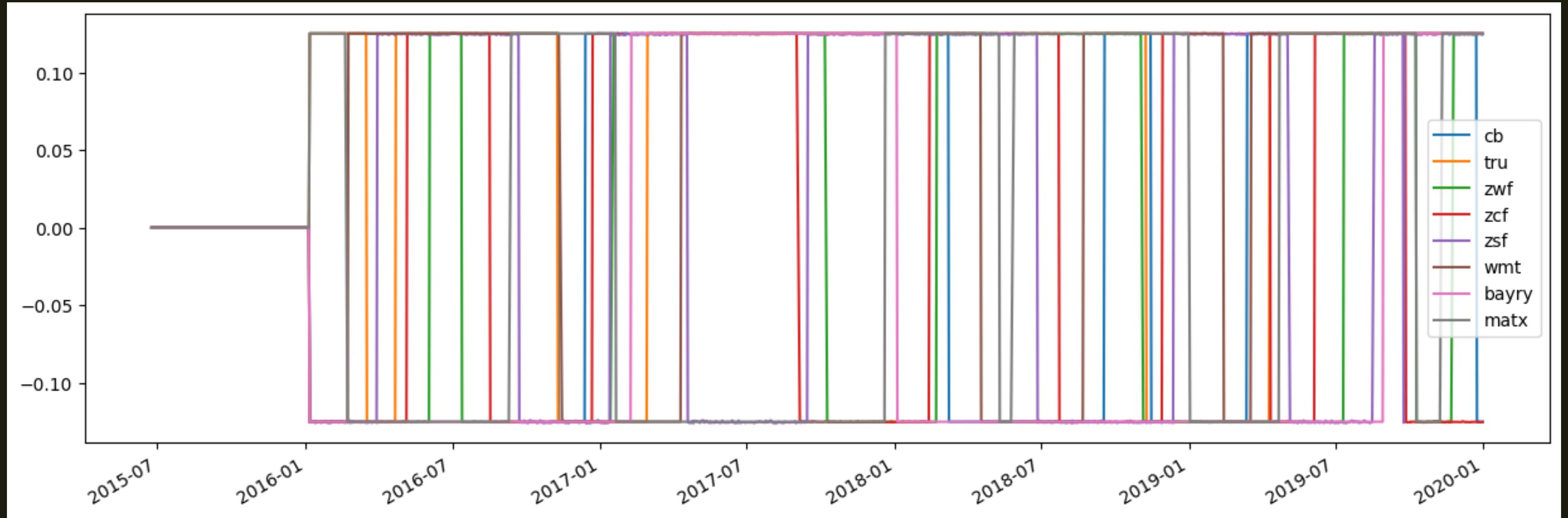
Appendix

Weight distribution – SMA - Test



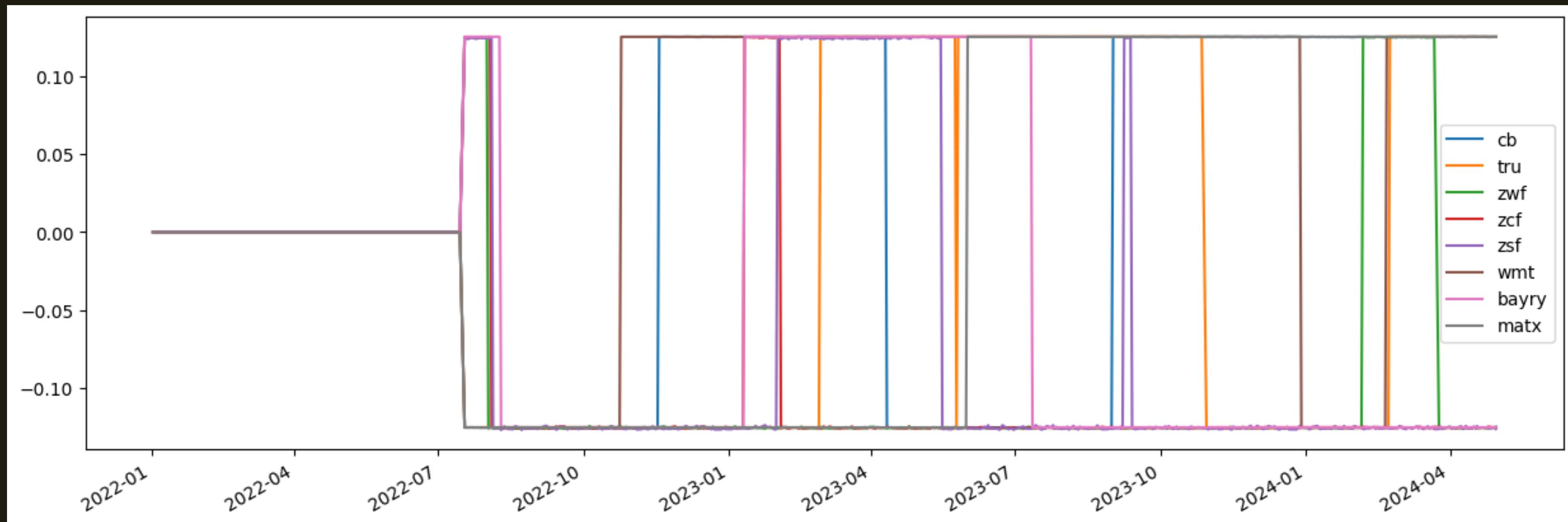
Appendix

Weight distribution – EMA - Train



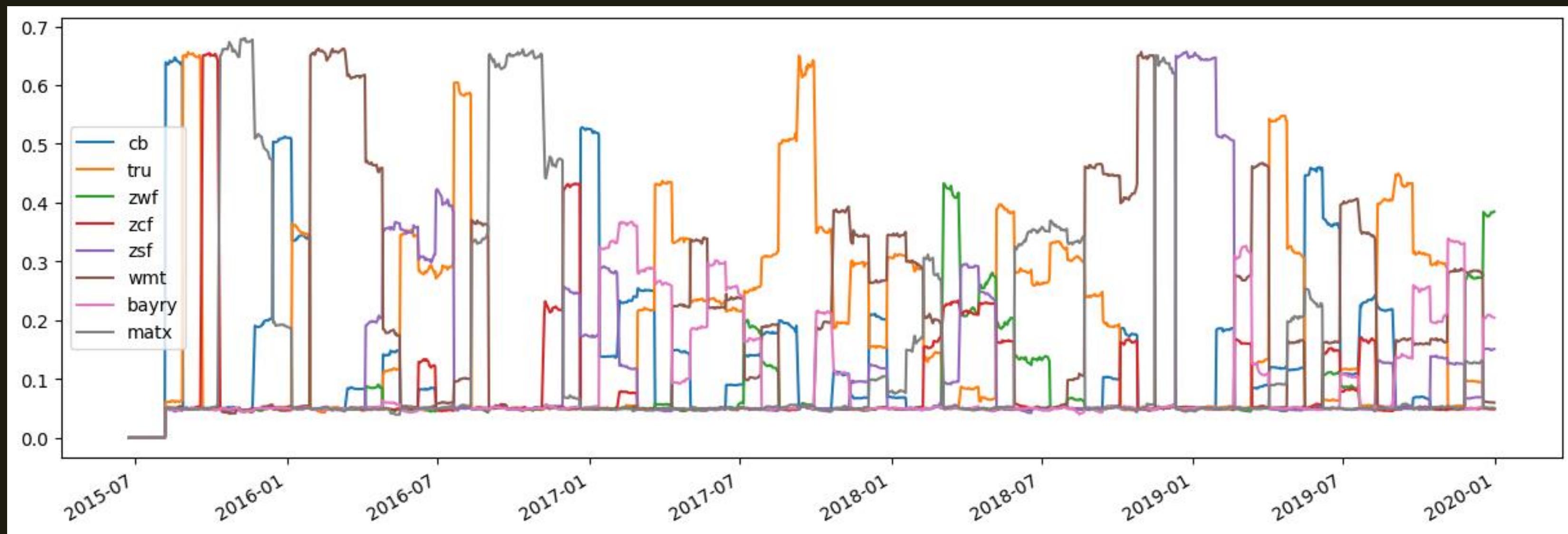
Appendix

Weight distribution – EMA - Test



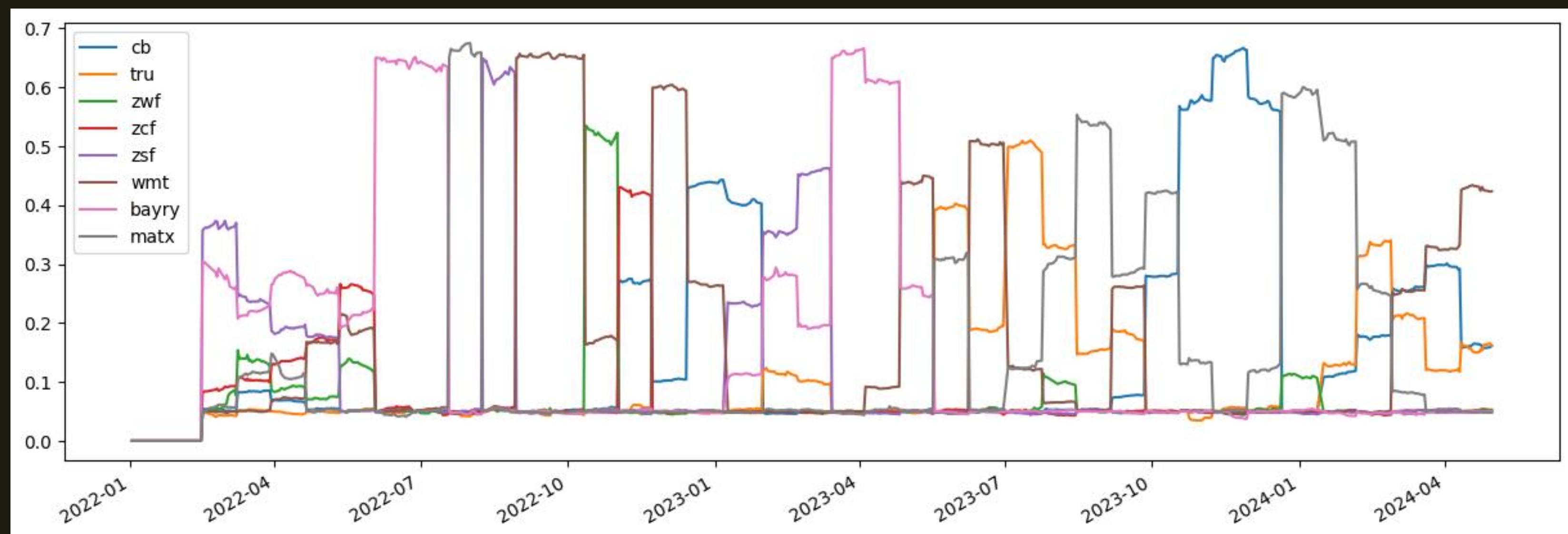
Appendix

Weight distribution – MVO - Train



Appendix

Weight distribution – MVO - Test



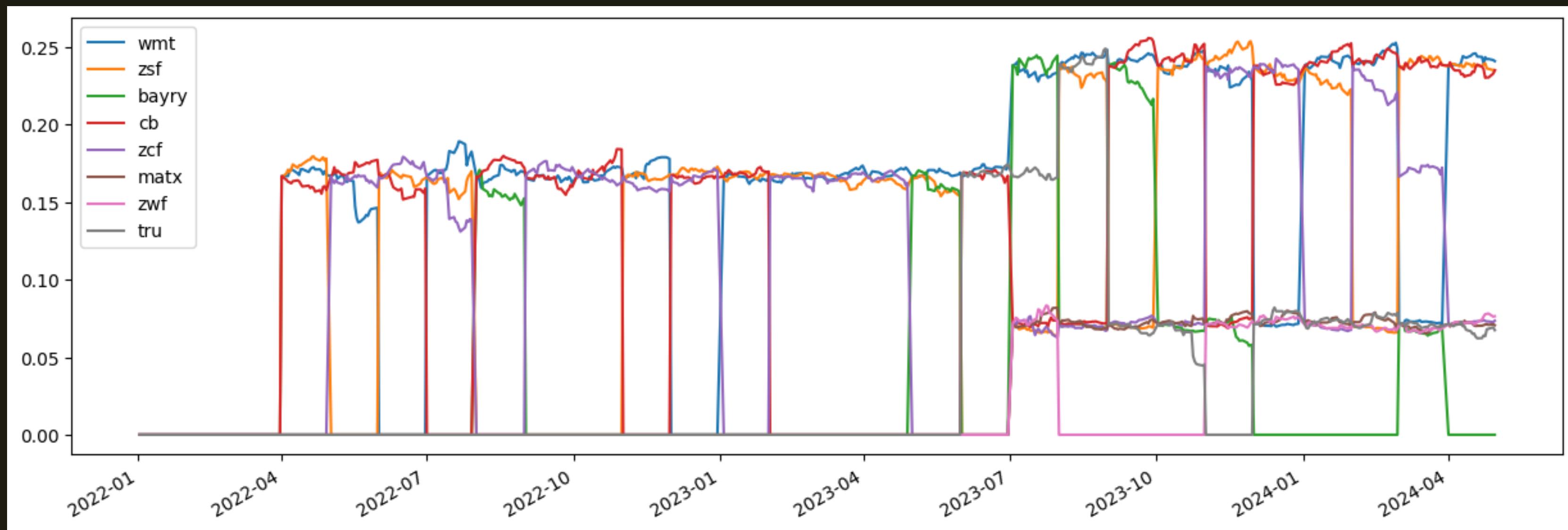
Appendix

Weight distribution – M&V - Train



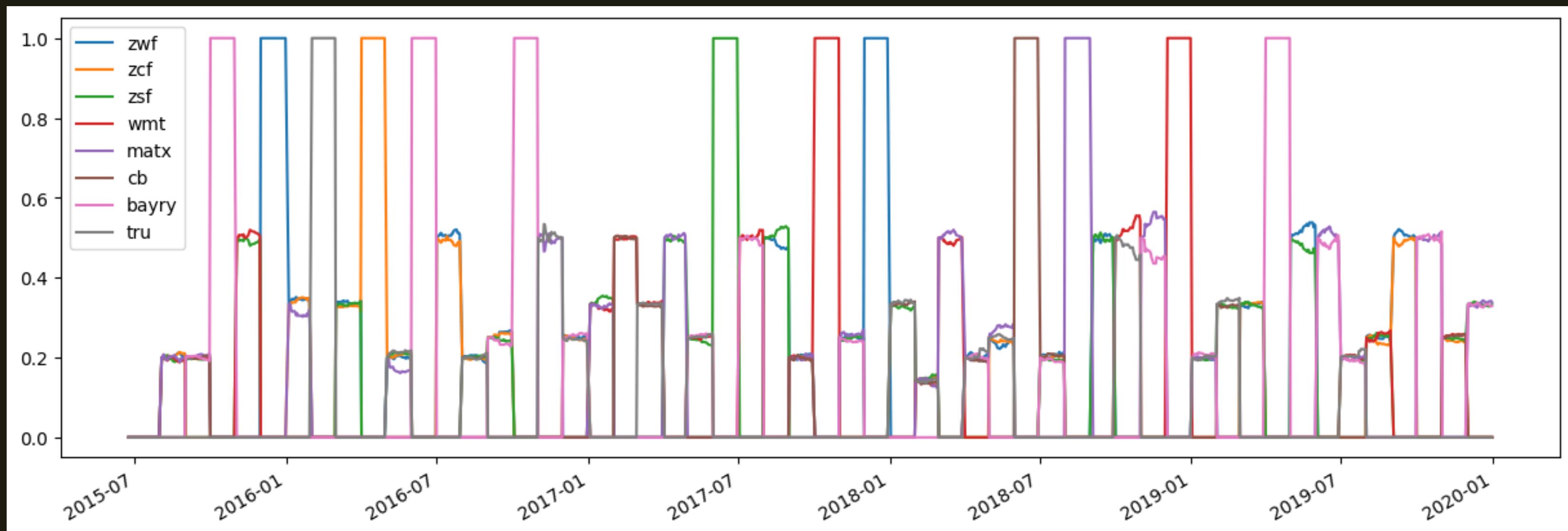
Appendix

Weight distribution – M&V - Test



Appendix

Weight distribution – RSI - Train



Appendix

Weight distribution – RSI - Test

