



Walk Forward Analysis

PRESENTED BY

Justin & Tay Han

PREPARED BY

Devan, Jasper, Ryan, Ryan,
Yu Han

Backtesting Strategy

The combination of Genetic Algorithms and Walk Forward Analysis through the elimination of event bias



Agenda

1	<u>Motivation</u>
2	<u>Event Bias Analysis</u>
3	<u>Walk Forward Analysis</u>
4	<u>Genetic Algorithms</u>
5	<u>Discussions</u>

Motivations



Standardization of Society's Backtesting Framework

Developing common, generalised backtesting framework



Amalgamation of Optimisation Techniques

Involves the combination of walk forward analysis and genetic algorithms.



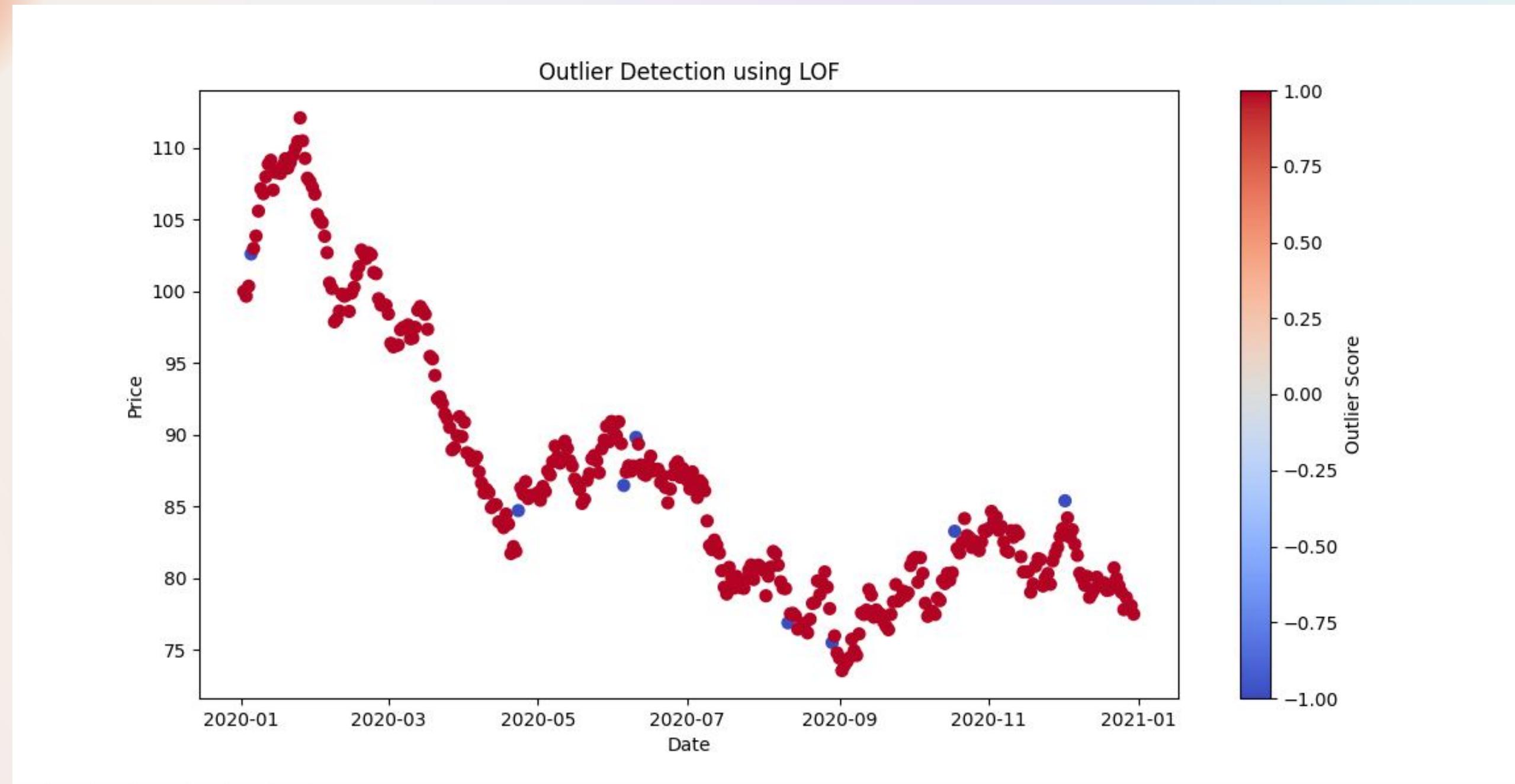
Increased Robustness / Generality

Prevention of overfitting through utilisation of walk forward analysis

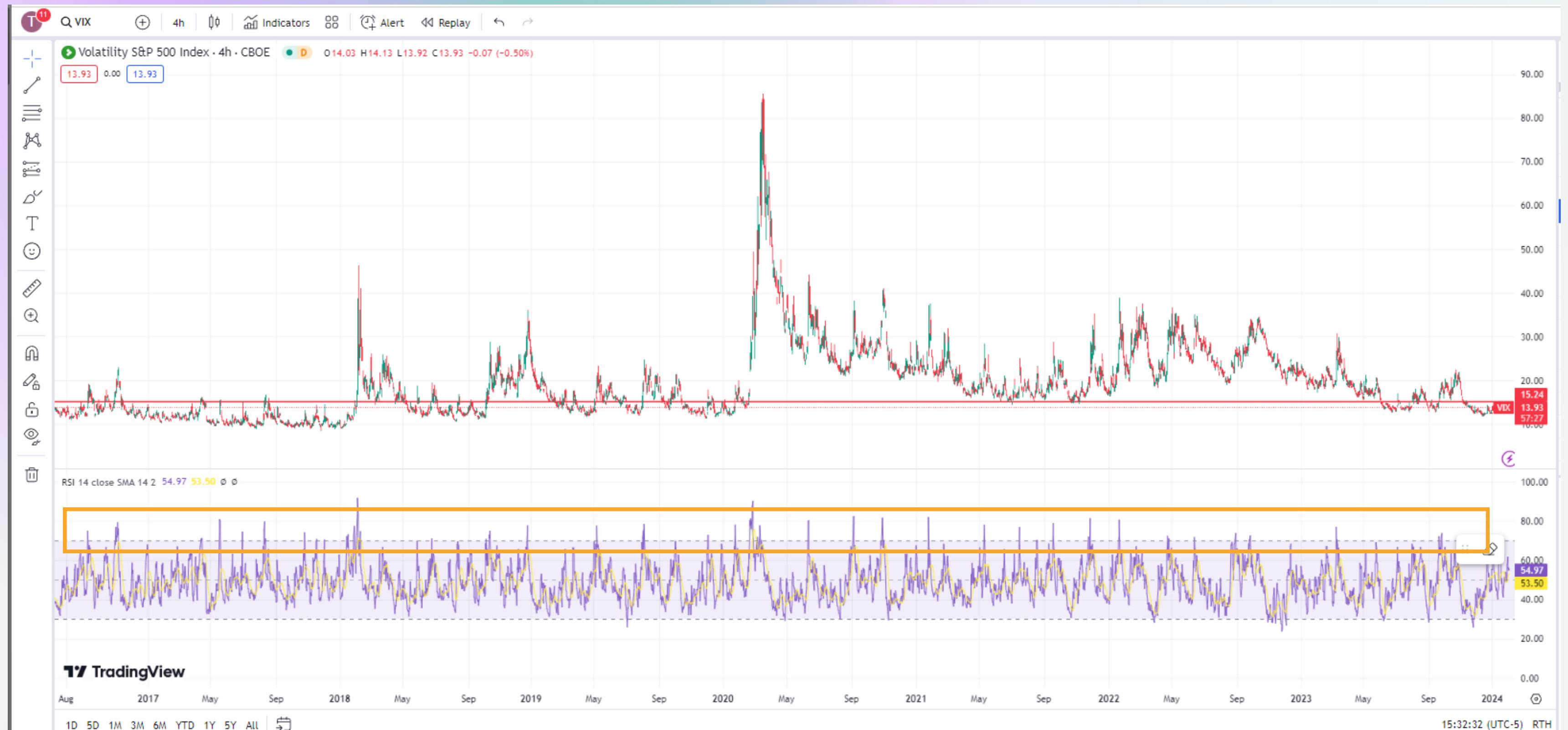


Event Bias Analysis #1

Utilization of the Local Outlier Factor



Event Bias Analysis #2



Walk Forward Analysis

◆ Anchored vs Unanchored

Utilising an **anchored strategy** to **increase generality** and **near term recency** of the backtesting methodology

◆ Increased Generality through permutating the Train-Test Split

The discovery of the walk backward and the “walk through the middle” TTS seemed to work well in backtesting the alphas.

◆ Decision on length of Optimisation Window and number of stages

Through industry research, length of window and number of stages are set at 3 years and 5 stages respectively for a total time frame of 10 years.

Genetic Algorithms

- ◆ Genetic Algorithms is excellent for noisy backgrounds (Fitzpatrick, 2002)
Great for the financial markets
- ◆ Highly Adaptable to increased number of parameters
This assists with the robustness of the inputs of our walk forward backtesting strategy.
- ◆ Limitations: The Design of the fitness variable
Current Fitness Variable is limited to the linear combination of sharpe ratio, more research and efforts have to be put in for fitness function engineering.

Walk Forward Analysis

Normal SMA Crossover Strat

Start	2004-02-02 00:00...
End	2020-01-31 00:00...
Duration	5842 days 00:00:00
Exposure Time [%]	98.88282
Equity Final [\$]	213765.464653
Equity Peak [\$]	292118.624632
Return [%]	113.765465
Buy & Hold Return [%]	857.21387
Return (Ann.) [%]	4.867659
Volatility (Ann.) [%]	26.146424
Sharpe Ratio	0.186169
Sortino Ratio	0.286697
Calmar Ratio	0.104619
Max. Drawdown [%]	-46.527585
Avg. Drawdown [%]	-5.166622
Max. Drawdown Duration	1780 days 00:00:00
Avg. Drawdown Duration	108 days 00:00:00
# Trades	205
Win Rate [%]	42.926829
Best Trade [%]	25.949932
Worst Trade [%]	-12.718676
Avg. Trade [%]	0.371277
Max. Trade Duration	148 days 00:00:00
Avg. Trade Duration	29 days 00:00:00
Profit Factor	1.293988

Implementation of GA

Start	2004-02-02 00:00...
End	2020-01-31 00:00...
Duration	5842 days 00:00:00
Exposure Time [%]	98.584906
Equity Final [\$]	1025986.45679
Equity Peak [\$]	1029382.087764
Return [%]	925.986457
Buy & Hold Return [%]	857.21387
Return (Ann.) [%]	15.680221
Volatility (Ann.) [%]	28.66473
Sharpe Ratio	0.547021
Sortino Ratio	0.961545
Calmar Ratio	0.363906
Max. Drawdown [%]	-43.088653
Avg. Drawdown [%]	-3.818863
Max. Drawdown Duration	1393 days 00:00:00
Avg. Drawdown Duration	42 days 00:00:00
# Trades	215
Win Rate [%]	52.093023
Best Trade [%]	34.191391
Worst Trade [%]	-12.407395
Avg. Trade [%]	1.088858
Max. Trade Duration	172 days 00:00:00
Avg. Trade Duration	27 days 00:00:00
Profit Factor	1.883716

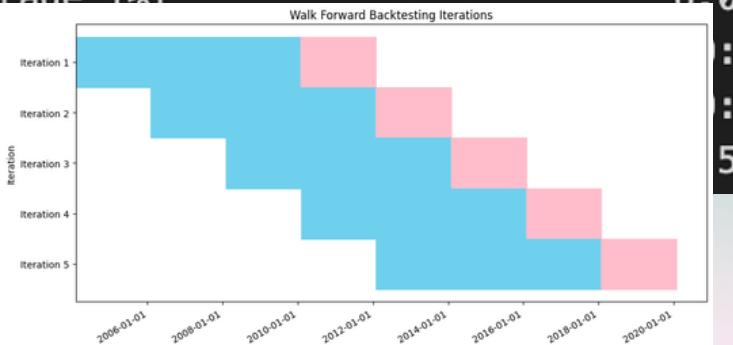
Implementation of WFA

Start	2004-02-02 00:00...
End	2020-01-31 00:00...
Duration	5842 days 00:00:00
Exposure Time [%]	91.236346
Equity Final [\$]	323625.004197
Equity Peak [\$]	324696.094524
Return [%]	223.625004
Buy & Hold Return [%]	857.21387
Return (Ann.) [%]	7.624039
Volatility (Ann.) [%]	24.908311
Sharpe Ratio	0.306084
Sortino Ratio	0.481758
Calmar Ratio	0.132713
Max. Drawdown [%]	-57.447645
Avg. Drawdown [%]	-3.031234
Max. Drawdown Duration	3801 days 00:00:00
Avg. Drawdown Duration	67 days 00:00:00
# Trades	20
Win Rate [%]	50.0
Best Trade [%]	217.286261
Worst Trade [%]	-28.948271
Avg. Trade [%]	6.048577
Max. Trade Duration	1247 days 00:00:00
Avg. Trade Duration	267 days 00:00:00
Profit Factor	3.572269

Walk Forward Analysis

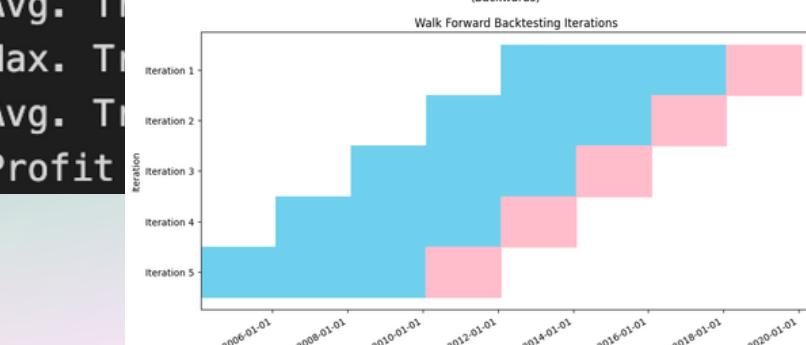
Implementation of WFA

Start	2004-02-02 00:00...
End	2020-01-31 00:00...
Duration	5842 days 00:00:00
Exposure Time [%]	91.236346
Equity Final [\$]	323625.004197
Equity Peak [\$]	324696.094524
Return [%]	223.625004
Buy & Hold Return [%]	857.21387
Return (Ann.) [%]	7.624039
Volatility (Ann.) [%]	24.908311
Sharpe Ratio	0.306084
Sortino Ratio	0.481758
Calmar Ratio	0.132713
Max. Drawdown [%]	-57.447645
Avg. Drawdown [%]	-3.031234
Max. Drawdown Duration	3801 days 00:00:00
Avg. Drawdown Duration	67 days 00:00:00
# Trades	20
Win Rate [%]	50.0
Best Trade [%]	217.286261
Worst Trade [%]	-28.948271
Avg. Trade [%]	6.048577
Max. Trade [\\$]	100000.000000
Avg. Trade [\\$]	10000.000000
Profit	572269



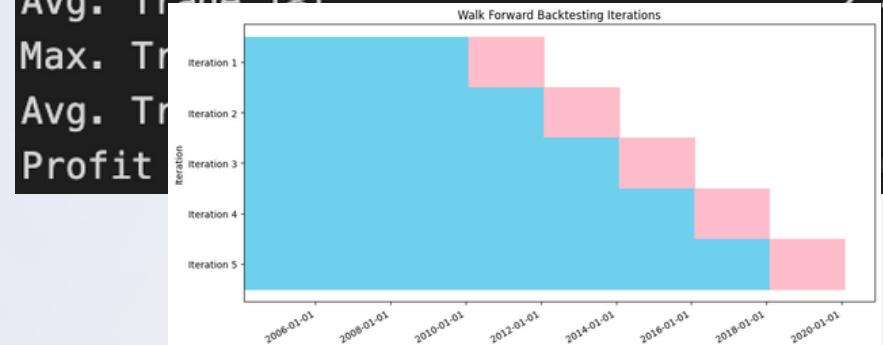
Implementation of WBA

Start	2004-02-03 00:00...
End	2020-02-03 00:00...
Duration	5844 days 00:00:00
Exposure Time [%]	97.914598
Equity Final [\$]	339889.883449
Equity Peak [\$]	344575.252995
Return [%]	239.889883
Buy & Hold Return [%]	884.50253
Return (Ann.) [%]	7.954716
Volatility (Ann.) [%]	25.591732
Sharpe Ratio	0.310831
Sortino Ratio	0.491329
Calmar Ratio	0.1566
Max. Drawdown [%]	-50.796248
Avg. Drawdown [%]	-4.485421
Max. Drawdown Duration	3130 days 00:00:00
Avg. Drawdown Duration	82 days 00:00:00
# Trades	63
Win Rate [%]	36.507937
Best Trade [%]	97.459867
Worst Trade [%]	-13.2667
Avg. Trade [%]	961089
Max. Trade [\\$]	100000.000000
Avg. Trade [\\$]	10000.000000
Profit	2025858



Implementation of AWF

Start	2004-02-03 00:00...
End	2020-02-03 00:00...
Duration	5844 days 00:00:00
Exposure Time [%]	96.847071
Equity Final [\$]	293677.625901
Equity Peak [\$]	297726.681444
Return [%]	193.677626
Buy & Hold Return [%]	884.502331
Return (Ann.) [%]	6.97221
Volatility (Ann.) [%]	25.164208
Sharpe Ratio	0.277069
Sortino Ratio	0.421095
Calmar Ratio	0.154844
Max. Drawdown [%]	-45.027384
Avg. Drawdown [%]	-4.195174
Max. Drawdown Duration	2363 days 00:00:00
Avg. Drawdown Duration	73 days 00:00:00
# Trades	45
Win Rate [%]	51.111111
Best Trade [%]	94.919031
Worst Trade [%]	-18.642928
Avg. Trade [%]	2423383
Max. Trade [\\$]	100000.000000
Avg. Trade [\\$]	10000.000000
Profit	099154



Walk Forward Analysis

Compare optimisation and walk forward

```
test_df = pd.DataFrame(test_data)
bt = Backtest(test_data, strategy=SmaCross, cash=100_000)
res = bt.run()

bt_optimised = Backtest(test_df, strategy=SmaCrossOptimised, cash=100_000)
res_optimised = bt_optimised.run()

bt_walk_forward = Backtest(test_df, strategy=SmaCrossWalkForward, cash=100_000)
res_walk_forward = bt_walk_forward.run()

bt_walk_backward = Backtest(test_df, strategy=SmaCrossWalkBackward, cash=100_000)
res_walk_backward = bt_walk_backward.run()

bt_anchored_walk_forward = Backtest(test_df, strategy=SmaCrossAchoredWalkForward, cash=100_000)
res_anchored_walk_forward = bt_anchored_walk_forward.run()

print("Normal Run Return [%]:", res["Return [%]"])
print("Genetic Algorithm Optimised Return [%]:", res_optimised["Return [%]"])
print("Walk Forward Optimised Return [%]:", res_walk_forward["Return [%]"])
print("Walk Backwards Return [%]:", res_walk_backward["Return [%]"])
print("Anchored Walk Forward Optimised Return [%]:", res_anchored_walk_forward["Return [%"]])
```

✓ 0.1s

```
Normal Run Return [%]: -3.839100764655217
Genetic Algorithm Optimised Return [%]: -8.542382714794702
Walk Forward Optimised Return [%]: 8.80348972766698
Walk Backwards Return [%]: 46.86364575290299
Anchored Walk Forward Optimised Return [%]: 139.975891055781
```

Discussion

Complementary Effects of WF/BA & GA

WF/BA allows for the timely prevention of overfitting by GA, adequately generalising the model

Success of the WBA

Interestingly, much success has been depicted for the WBA due to an increase in permutation and generality of the model

Fitness Reformation

More Research has to be put into creating a viable Fitness Function



Thank you!