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The results presented may include historical simulations (backtests) and may not reflect all execution costs and constraints (including commissions, spreads, slippage, taxes, and liquidity limitations). Historical or simulated performance is not a guarantee of achieving similar results in the future.

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The results shown in the reports are indicative only and depend on the adopted methodology, data selection, parameters, assumptions, and the way risk and return measures are calculated. Actual results may differ materially from historical or simulated results.

The author may hold positions in the instruments discussed or may apply a similar approach in practice. The information contained in the reports may change without prior notice.

Methodology

TradingEdge.Pro's methodology describes a multi-step process for building and validating trading strategies, structured into two parts: strategy development and testing, and practical use. In the testing phase, a strategy is defined as a set of objective rules, validated through initial tests, optimised, and assessed for stability (robustness), and then evaluated using Walk-Forward Analysis. The detailed testing assumptions (including the instrument universe, in-sample/out-of-sample periods, data sources, transaction costs, and execution rules) are described in the "Testing Specification" document. The full methodology and metric definitions are available on the TradingEdge.Pro "Methodology" page.

RSI PowerZone v.3

Investment Strategy Testing Summary

PowerZone RSI strategy is a swing trading investment technique that uses **a multi-day RSI (Relative Strength Index)** and a downward correction of an instrument in **an upward trend** (quotes above **the long-term moving average)**. The key assumption of the strategy is **to open long positions during the correction** and **possibly pyramid it** when the price continues to fall, and then **close it after the price increases.**

Compared to the RSI PowerZone v.2 version of this strategy, the parameters have been **optimized** using **The Grid technique Search** and an **exit element was added to protect against excessive losses.**

The optimal optimization window for WFA tests is **1460/365 days,** and the results for the period **01.01.1995 - 31.12.2024** haughty:

- **Item size:** corresponding to the risk of 2.0% of the total capital, with a hypothetical stop loss order located 2 x ATR (40 days) away from the position opening point;
- **CAGR:** 10.4%;
- **MAR:** 0.31;
- **Maximum drawdown:** 33.1%.

It is worth noting that **at a position size of 2.0% of capital, the drawdown in 99% of the Monte Carlo simulations was 62% or less,** which is **average** compared to **the in-sample and out-of-sample data,** where **the drawdown was 29%.** Ultimately, **the position size should be adjusted to an acceptable level of drawdown consistent with the individual risk profile.**

The strategy passed both the stability tests as well as the Walk Forward Analysis (WFA) tests. However, **it has some significant limitations** that should be taken into account:

- **Relatively low MAR** compared to trend- following strategies. However, the goal of this strategy is different than in the case of trend- following strategies.
- **Large drawdown during a period of strong declines on the stock market (COVID),** which means susceptibility to sudden market changes.

Despite these limitations, the RSI PowerZone v.3 strategy **can be an effective tool for traders who prefer swing trading strategies,** as it remains stable in a variety of market conditions and a wide range of parameters. **I cannot** emphasize enough that for **the strategy to work** in real conditions, it must also work on **suboptimal parameters** and in **suboptimal conditions.** In short, **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly reflect the problem of many optimizations:

"I've never seen a strategy that didn't work in backtests."

contact@tradingedge.pro
+48-698-630-421

We don't know the future, we don't know future market conditions, but if we know that our strategy **has historically generated acceptable results** in various market conditions and across various parameter ranges, then we are **one step ahead of other** market participants.

Contents

Step 1: Formulate an investment strategy

The RSI PowerZone strategy is a short-term investment technique developed by Larry Connors, based on the **RSI (Relative Strength Index)** and a downward correction of an instrument in an uptrend (defined by quotes above **the long-term moving average)**. The strategy aims to generate buy signals by analyzing RSI levels in the context of the prevailing market trend. For the purposes of this test, **long positions** on **stock indices, bonds, gold** and **the dollar index were used,** which allows us to assess the effectiveness of the strategy across a wide range of asset classes.

The strategy uses:

- **RSI levels** to open and close a position (take profit),
- **Long-term moving average** to determine an uptrend.

After opening the first long unit, **if the market continues to fall, the second unit is opened** – this is **the maximum number of units** in the portfolio. In the tests below, **the opening and closing of the position occurs at the opening price of the next day,** after generating a buy or sell signal.

Characteristics of the strategy and its strengths and weaknesses:

- **Combines RSI with the trend** – moving average and RSI correction analysis increases the effectiveness of entry and exit signals.
- **Simple implementation** – uses two basic indicators (RSI and moving average), making it easy to understand and implement.
- **Taking profits** – involves closing a position after a move in the expected direction.
- **Pyramiding a position** – adding a second position if the market continues to decline after opening the first long position.
- **False signals in case of a dynamic trend change** – during periods of a rapid trend change, the RSI may generate losing signals.
- **Dependence on parameters** – effectiveness depends on the appropriate selection of RSI parameters, which requires optimization.

RSI PowerZone is a strategy that, while simple to implement, requires caution due to its susceptibility to false signals. Its application requires careful optimization and risk management, especially in volatile market conditions.

Step 2: Define investment principles

Below is **the pseudocode** for the **PowerZone RSI strategy** on daily data:

1. **Calculating Indicators:**
    a. **XX-Day RSI:** Used to identify short-term oversold and overbought conditions in the market.
    b. **YY-day SMA:** Determines the long-term trend of the market. If the price is above the SMA-YY, it is considered to be in an uptrend.
2. **Generating Input Signals:**
    a. **First Long Position:**
        i. It is opened only when the market is in an uptrend (Price > SMA-YY) and the RSI drops below the HH1 level, which indicates an oversold condition.
        ii. A position is opened at the opening of the next day on which the conditions are met.
    b. **Adding a Second Unit:**
        i. If, during an open position, the closing price falls below the opening level of the first unit and the RSI remains below the HH1 level, an additional unit is opened, which increases the involvement in the position.
        ii. This is intended to take advantage of a further oversold market.
3. **Generating Output Signals:**
    a. The position (or positions if a second unit was added) is closed when the RSI rises above the HH2 level, or the price falls below the SMA-YY moving average.
    b. The close occurs at the opening price of the next day, after the signal is generated.
4. **Loss Management:** Long positions are closed at a loss when the instrument's closing price falls below the SMA-YY moving average.
5. **Daily Monitoring:**
    a. RSI and SMA values are calculated every day.
    b. The system checks whether the entry, addition of a position or exit conditions are met and takes appropriate actions the next day upon opening.
6. **Additional Notes:**
    a. **No Short Positions:** The strategy focuses only on long positions in an uptrend.
    b. **Financial Instruments:** For the purposes of this test, **long positions** on **stock indices, bonds, gold** and **the dollar index were used.**

The above rules have been described in a way that allows them to be directly converted into a script in the chosen testing platform, which ensures the accuracy of the historical simulation and the reliability of the test results.

The tests are carried out assuming that the risk of one position is **2.0% of the total capital,** with **a hypothetical stop loss order located 2 x ATR (40 days)** away from the position opening point.

Step 3: Conduct a preliminary test of the investment strategy

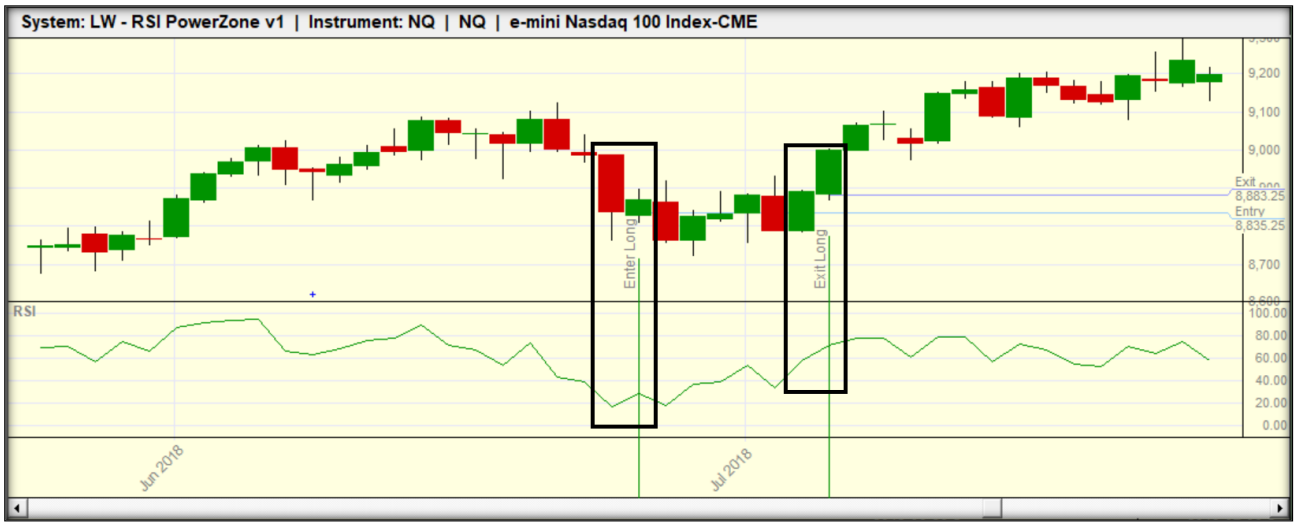
Below are some purchase and sale transactions that allow you to verify the following aspects:

- **Correctness of generated signals;**
- **Direction of opening position;**
- **Moment of opening a position;**
- **Position opening price;**
- **Moment of closing the position;**
- **Closing price of the position;**
- **Compliance of the transaction with the theoretical assumptions of the investment strategy.**

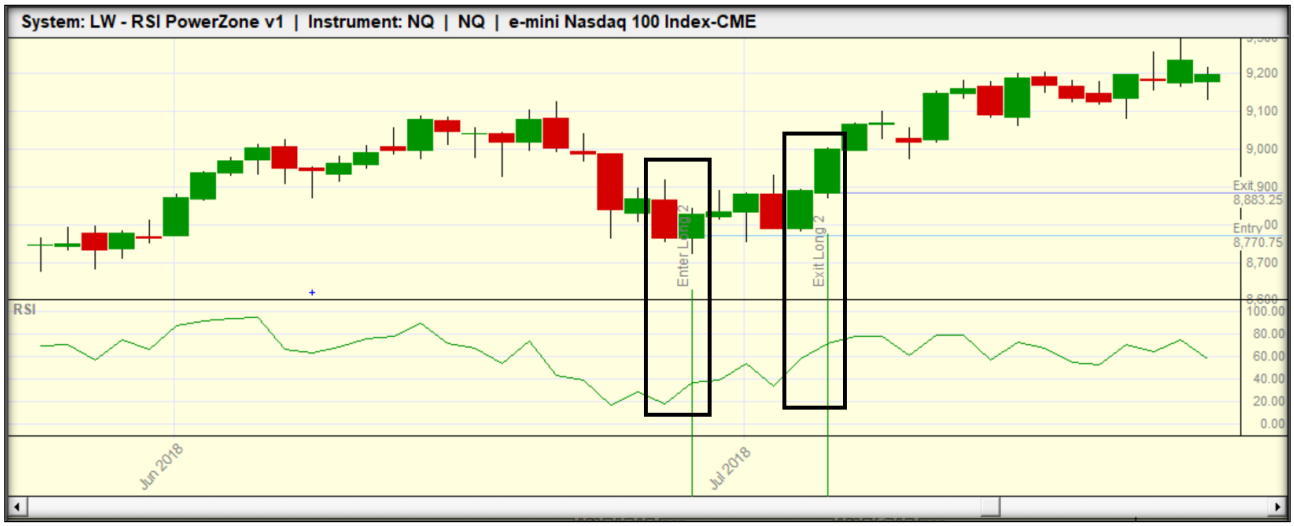
At this stage **it does not matter** whether the transactions are **profitable,** what **instrument was used** or whether they took place **recently** or **in the distant past.** The key is **to check whether the transactions are generated correctly** and in accordance with the assumptions described in the previous step.

The first transaction was made on a futures contract for the Nasdaq100 index. At the end of June 2018, the quotes were above **the 200-day moving average** (not visible on the chart), and the **RSI indicator value fell below 30,** which generated a signal to open a long position (**the first candle in the rectangle on the left)**. The position was opened the next day at the opening price (**the second candle in the rectangle on the left)**.

After several days of sideways movement, in early July 2018 the market rose slightly, raising the **RSI value to 55,** which signaled the closing of the position (**the first candle in the rectangle on the right)**. The position was closed the next day at the opening price (**the second candle in the rectangle on the right)**. **The system worked correctly.**



If we look at the above example, we can see that after the first position was opened, the market fell the next day and **the closing price fell below the opening price of the first unit (RSI remained below 30 the whole time).** This activated **the second buy order** (**the first candle in the left-hand rectangle)**. The second long position was opened the next day at the opening price (**the second candle in the left-hand rectangle)**.



The position moved in **a sideways trend for several days until it increased slightly** in early July 2018, raising the **RSI indicator to 55,** which **signaled the closing of the position** (**the first candle in the rectangle on the right)**. The position was closed **the next day at the opening price** (**the second candle in the rectangle on the right)**. The system worked correctly.

Once we are sure that the transactions are generated correctly, we can proceed to the first test of the strategy on the full **in-sample data set.** These tests are conducted on **the basic parameters** that were **proposed by the creator, Larry Connors.**

First of all, **we reject strategies that linearly lose capital.** If a strategy exhibits such a pattern, it is a clear signal that any parameter optimization does not make sense.

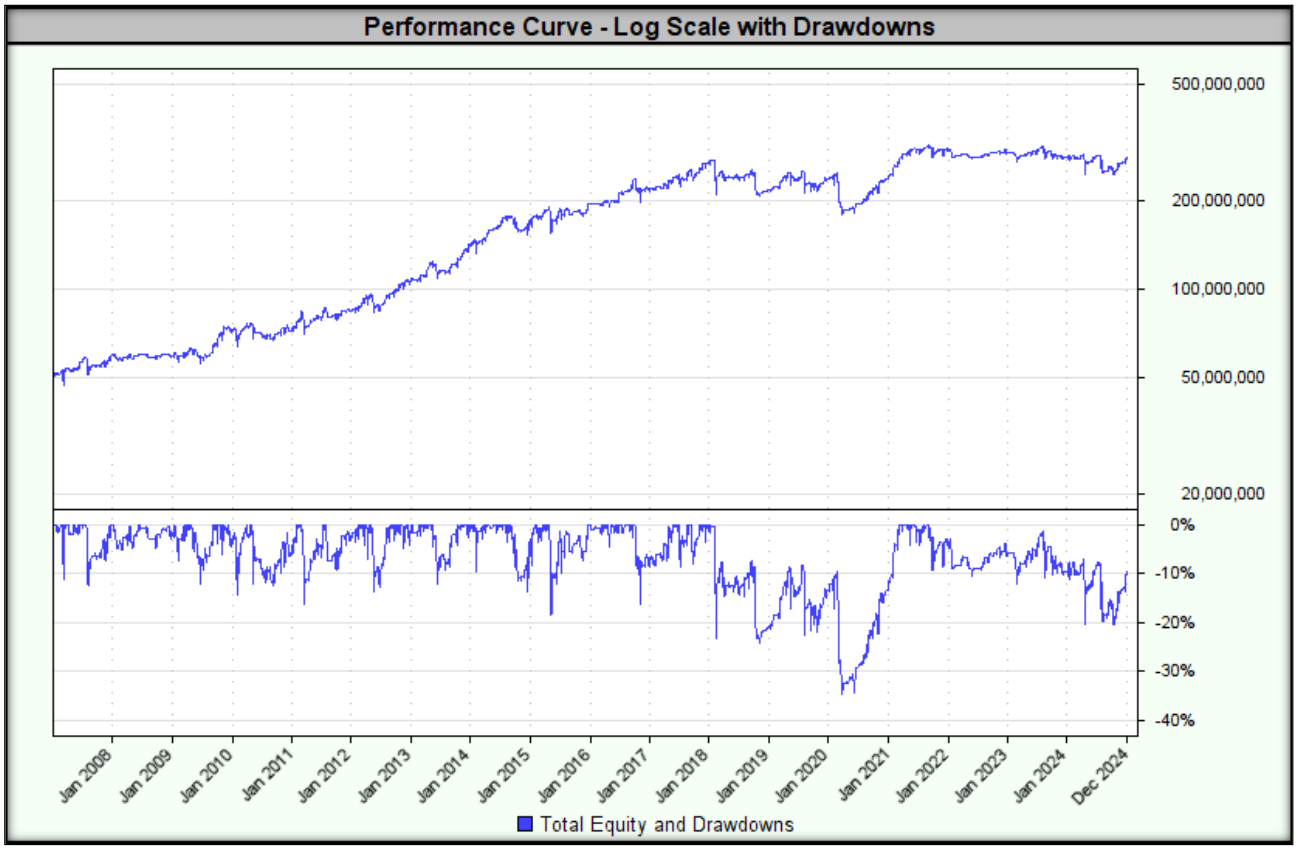
Our basic expectation is that the strategy generates **positive results,** even if they are at a low level.

Tested base parameters:

- **Length of the moving average (SMA):** 200 days;
- **RSI Lengths:** 4 days;
- **RSI Entry Threshold:** 30;
- **RSI Exit Threshold (take profit):** 55;
- **Stop loss:** the closing price of the instrument falls below the moving average;
- **Method of opening a position:** at the opening price of the next day;
- **Position size:** corresponding to the risk of 2.0% of the total capital, with a hypothetical stop loss order located 2 x ATR (40 days) away from the position opening position;
- **Size of 1 unit:** 50%;
- **Size 2 units:** 50%;
- **Position direction:** long positions (buy) only.

The test result is shown below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Indicators/Measures	Concluding a transaction at the opening price
CAGR%	10.0%
MAR Ratio	0.29
RAR%	11.6%
R- Cubed	0.36
Robust Sharpe Ratio	0.76
Max Drawdown	34.6%
Wins	67.5%
Losses	32.5%
Average Win%	0.49%
Average Loss %	0.74%
Win/ Loss Ratio	0.67
Average Trade Duration (days)	7
Percent Profit Factor	1.38
SQN	-
Number of transactions	2060

In summary, the system works properly and generates signals as expected. Additionally, tests on basic parameters have yielded satisfactory results. We can now move on to the most interesting stage of creating an investment strategy – **optimization and stability.**

Step 4: Optimization and assessment of investment strategy stability

This stage of strategy creation and testing is **crucial,** as it determines how **effective** the strategy will be in **real conditions. I cannot** emphasize enough that for **a strategy to work** in real conditions, it must also work on **suboptimal parameters** and in **suboptimal conditions.** In a word – **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly reflect the problem of many optimizations:

"I've never seen a strategy that didn't work in backtests."

My goal is not to find **optimal parameter values** – **my goal** is to find **a wide range of parameters** for which the strategy will generate **acceptable results. We don't know the future,** we don't know future market conditions, but if we know that our strategy **has historically generated acceptable results** in various market conditions and across various parameter ranges, then we are **one step ahead of other** market participants.

What **parameters to choose** for the next period is the subject of considerations in **Step 5 of the "Walk Forward Analysis",** but before we get to that, **we need to know whether our strategy is stable** at all.

1. Stability across a wide range of optimized parameters

PowerZone v.3 Strategy in this version it assumes **optimization of parameters using The Grid** method **Search.** It consists of **full optimization of all indicated parameters by creating a wide range of possible combinations.** Our goal is to find such **parameter ranges** that **the strategy remains stable (robust),** which will allow us to assess its usefulness in real market conditions.

The key criterion for assessing stability is that all test results must show a positive MAR value and the maximum drawdown must not exceed 250% of the drawdown value for the result with the highest MAR. If any test generates a negative MAR value or if the drawdown exceeds 250% of the drawdown value for the result with the highest MAR, the strategy is rejected completely.

In the first step, we test the stability of the parameters on **the in-sample data.** For this purpose, we determine the ranges of parameter **values** so that **the quotient of the highest and lowest values of the range was at least 150%.**

In the tested strategy, the ranges defined in this way are:

- **Moving average lengths (SMA):** range **200-300 days (step: 10);**
- **RSI Lengths:** Range **3-4 days (step: 1);**
- **RSI Entry Threshold:** range **19-29 (step: 1);**
- **RSI Exit Threshold (take profit):** range **53-80 (step: 1).**

The lowest MAR value of 0.10 was achieved for the following parameters:

- **Length of the moving average (SMA):** 300;
- **RSI lengths:** 3;

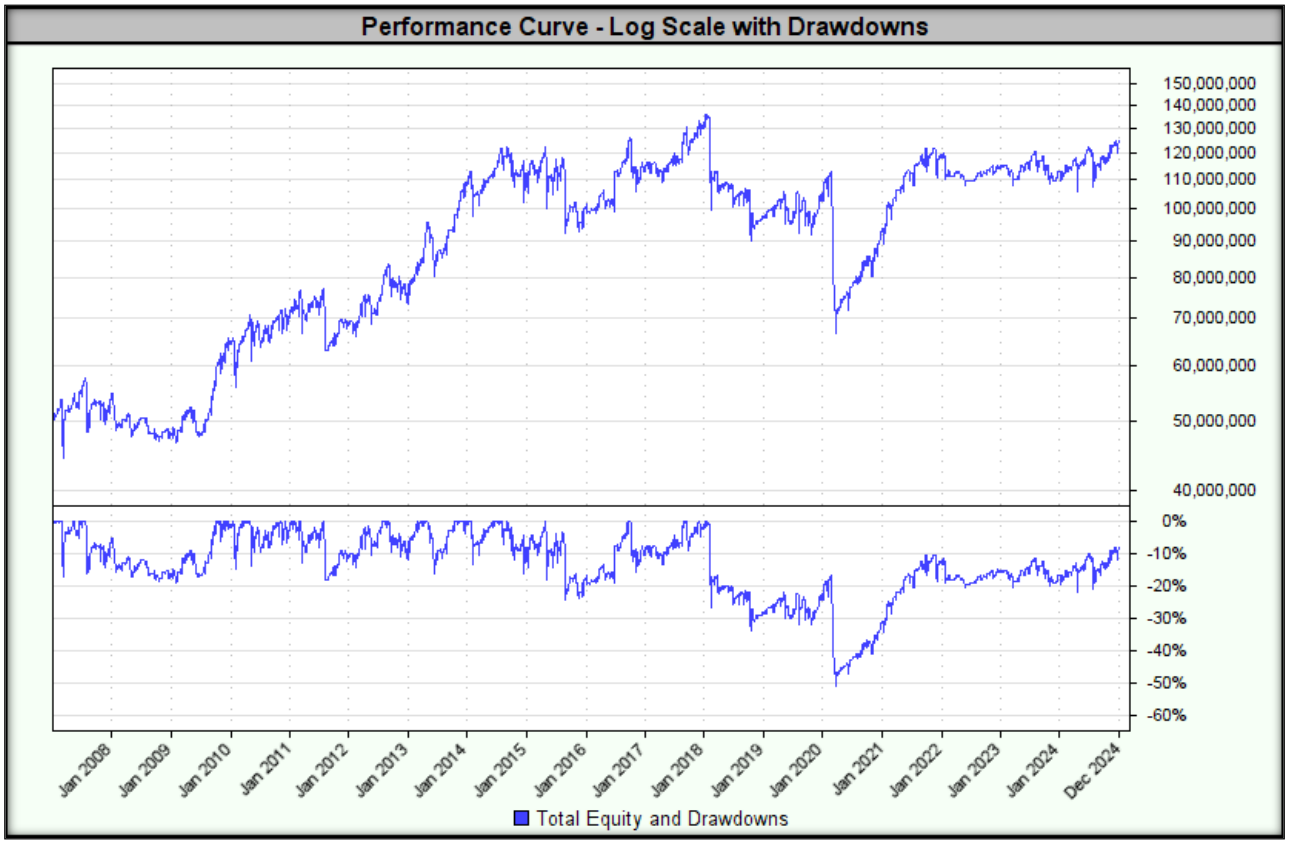
- **RSI Entry Threshold:** 29;
- **RSI Exit Threshold (take profit):** 53.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
6441	300	3	29	53	$123,766,980.31	5.16%	0.10	0.38	0.32	50.9%	83.7	3042
281	200	3	29	53	$123,913,531.20	5.17%	0.10	0.39	0.36	50.6%	83.2	2902
6442	300	3	29	54	$126,650,872.53	5.30%	0.10	0.39	0.33	51.4%	83.7	3020
282	200	3	29	54	$128,215,939.97	5.37%	0.11	0.40	0.38	50.9%	83.2	2882
197	200	3	26	53	$121,932,318.39	5.08%	0.11	0.41	0.42	47.4%	83.7	2529
897	210	3	29	53	$133,232,028.46	5.60%	0.11	0.41	0.36	50.2%	83.7	2909
6357	300	3	26	53	$129,419,942.96	5.43%	0.11	0.42	0.38	48.5%	83.7	2667
6443	300	3	29	55	$135,779,914.07	5.71%	0.11	0.41	0.37	50.8%	83.7	3002
5825	290	3	29	53	$134,640,289.84	5.66%	0.11	0.41	0.34	50.2%	83.7	3035
2129	230	3	29	53	$131,264,692.44	5.51%	0.11	0.41	0.37	48.9%	83.7	2959
2130	230	3	29	54	$132,503,616.70	5.56%	0.11	0.41	0.37	49.1%	83.7	2937

Below is a graph of the equity curve for **the strategy with the lowest MAR.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



The highest MAR value of 0.53 was achieved for the following parameters:

- **Length of the moving average (SMA):** 250;
- **RSI lengths:** 4;
- **RSI Entry Threshold:** 19;
- **RSI Exit Threshold (take profit):** 73.

The highest MAR value was accompanied by **a drawdown of 24.2%.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
3409	250	4	19	73	$434,031,352.32	12.76%	0.53	1.03	1.09	24.2%	14.9	848
3437	250	4	20	73	$436,245,285.75	12.79%	0.51	0.95	1.03	25.1%	18.4	927
3408	250	4	19	72	$402,471,941.06	12.29%	0.51	1.02	1.11	24.2%	14.5	853
3436	250	4	20	72	$408,692,757.64	12.38%	0.49	0.94	1.03	25.1%	17.9	935
1561	220	4	19	73	$392,921,316.73	12.14%	0.49	0.99	1.12	24.9%	21.5	816
1316	220	3	21	80	$760,370,322.61	16.33%	0.48	0.86	1.00	33.7%	39.8	1554
1315	220	3	21	79	$644,354,105.99	15.26%	0.48	0.82	0.96	31.6%	41.3	1572
3661	250	4	28	73	$582,595,004.00	14.62%	0.48	0.79	0.90	30.4%	28.1	1538
4025	260	4	19	73	$416,330,642.23	12.50%	0.48	1.02	1.11	26.0%	14.9	856
1589	220	4	20	73	$405,176,078.61	12.33%	0.48	0.92	1.11	25.7%	27.3	891
3407	250	4	19	71	$353,525,672.86	11.48%	0.48	0.97	1.12	24.0%	14.0	855

Below is a graph of the equity curve for **the strategy with the highest MAR.**

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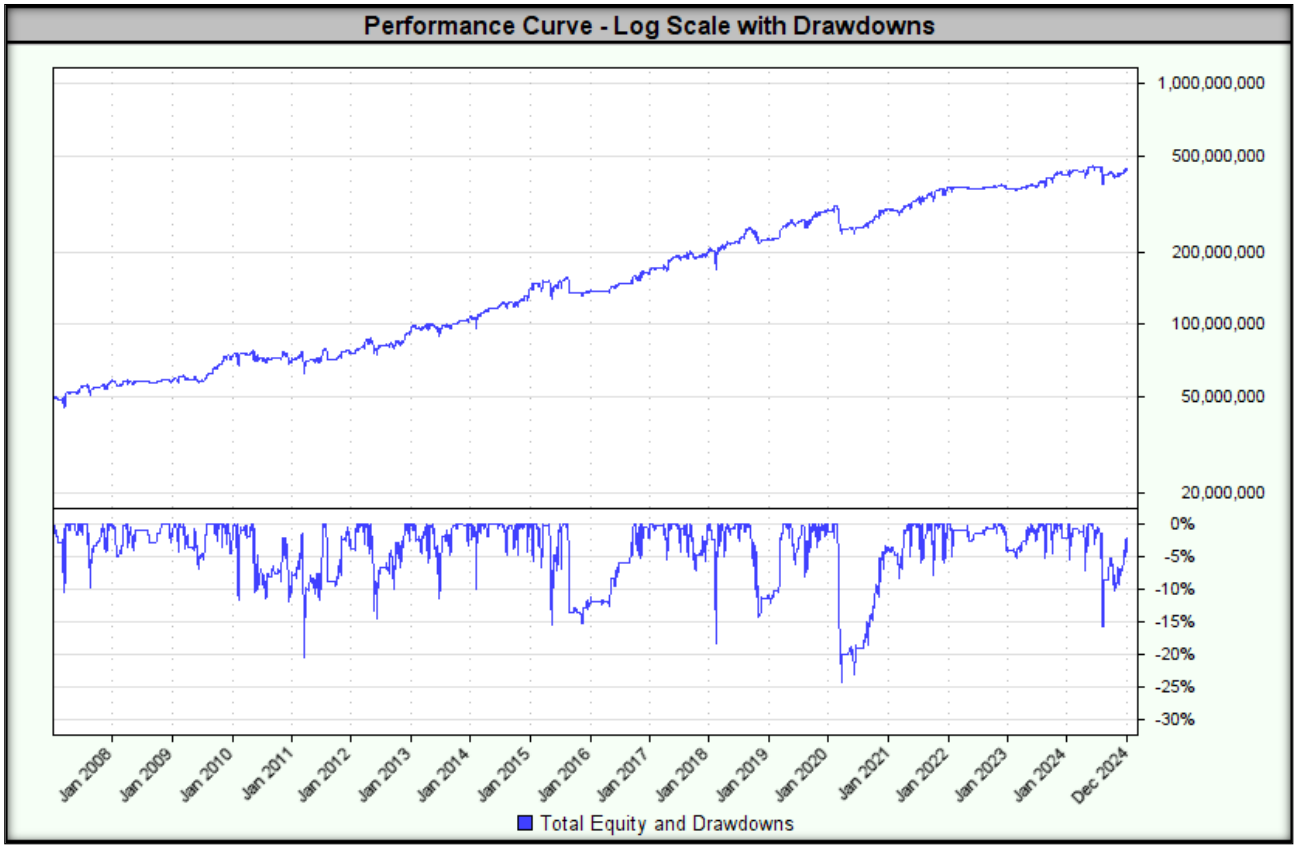


For all combinations of tested parameter ranges, **the highest drawdown was 55.7%.**

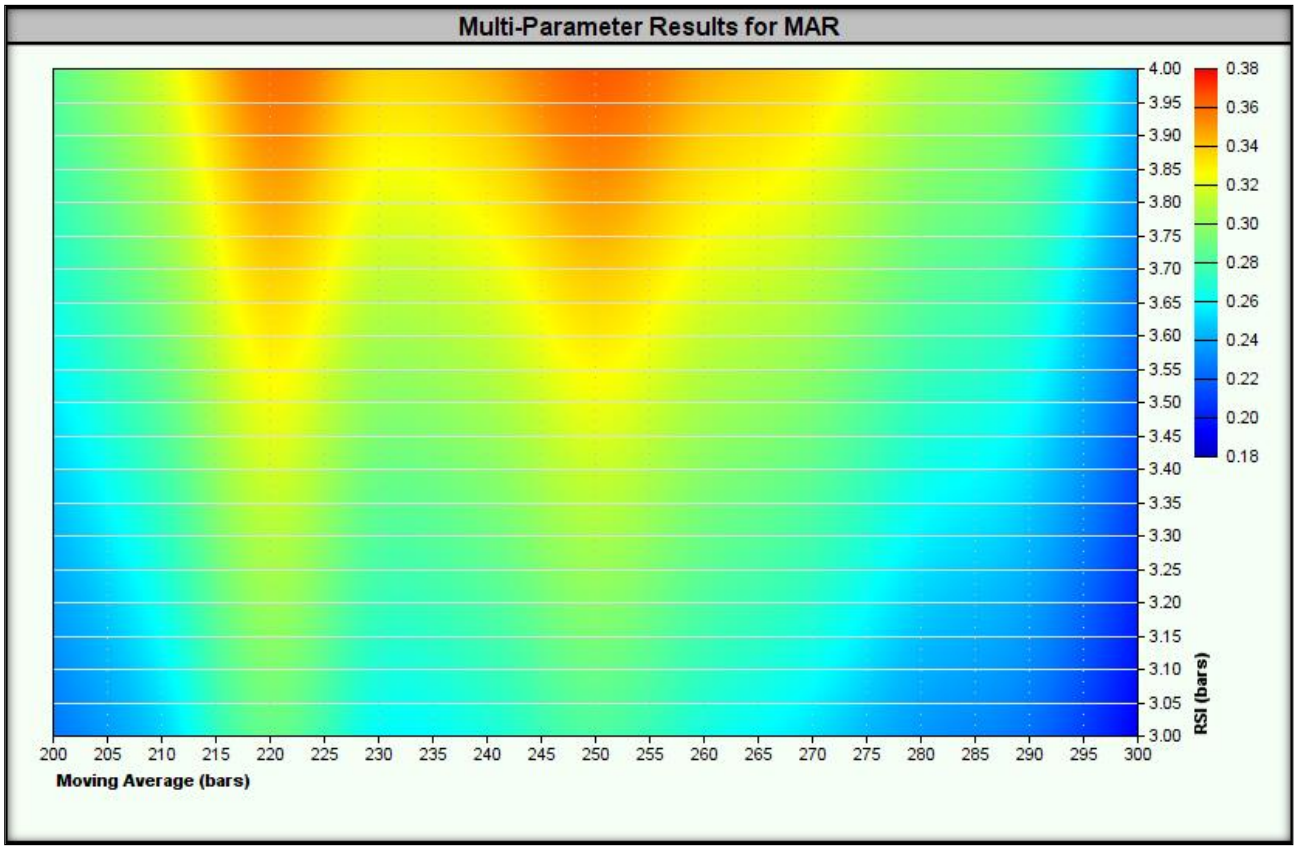
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

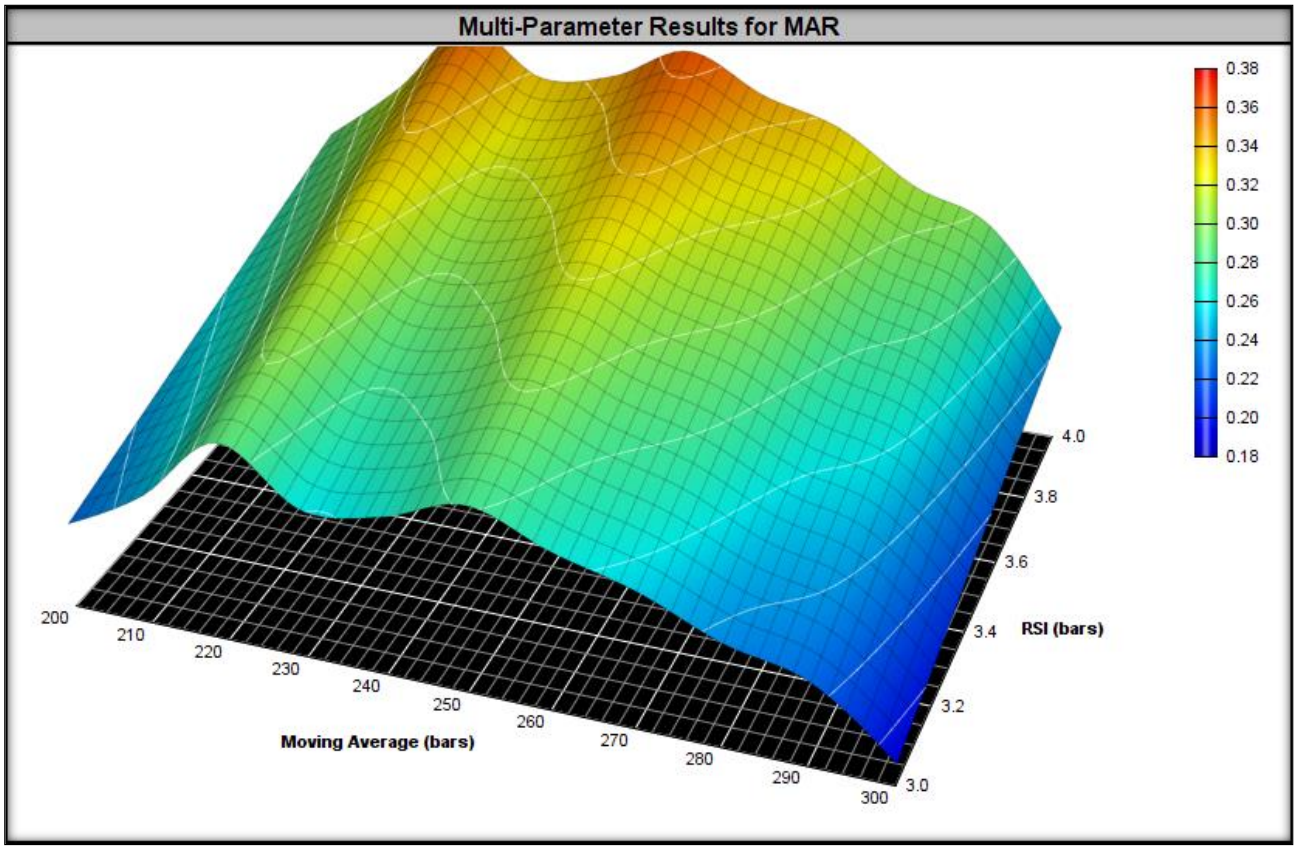
Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
6453	300	3	29	65	$210,668,302.18	8.32%	0.15	0.50	0.50	55.7%	83.7	2706
6452	300	3	29	64	$183,921,751.75	7.50%	0.14	0.46	0.42	55.5%	83.7	2733
6425	300	3	28	65	$238,054,913.83	9.06%	0.16	0.54	0.53	55.3%	83.7	2604
6424	300	3	28	64	$207,008,387.64	8.21%	0.15	0.50	0.45	55.1%	83.7	2629
6397	300	3	27	65	$247,181,997.01	9.29%	0.17	0.56	0.57	54.9%	83.7	2528
6440	300	3	28	80	$336,560,452.58	11.18%	0.21	0.56	0.61	54.5%	51.4	2012
6468	300	3	29	80	$324,225,092.24	10.94%	0.20	0.55	0.61	54.5%	35.8	2077
6396	300	3	27	64	$218,722,511.75	8.54%	0.16	0.52	0.49	54.3%	83.7	2552
6454	300	3	29	66	$186,036,339.14	7.57%	0.14	0.46	0.46	53.9%	83.7	2663
6412	300	3	27	80	$361,381,390.21	11.62%	0.22	0.58	0.65	53.5%	58.3	1974
6426	300	3	28	66	$208,423,570.07	8.25%	0.15	0.49	0.49	53.4%	83.7	2565

In summary, the strategy **passed the stability test** in a wide range of optimized parameters on in-sample data because:

- **MAR value** – which indicates the stability of the strategy in various market conditions.
- **The maximum drawdown did not exceed 250% of the drawdown value** for the result with the highest MAR (**55.7% vs. 24.2%)** – which means an acceptable risk of deep capital drawdowns.

Heatmaps for the tested ranges are presented below.




Multi-Parameter Results for MAR
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Moving Average (bars)
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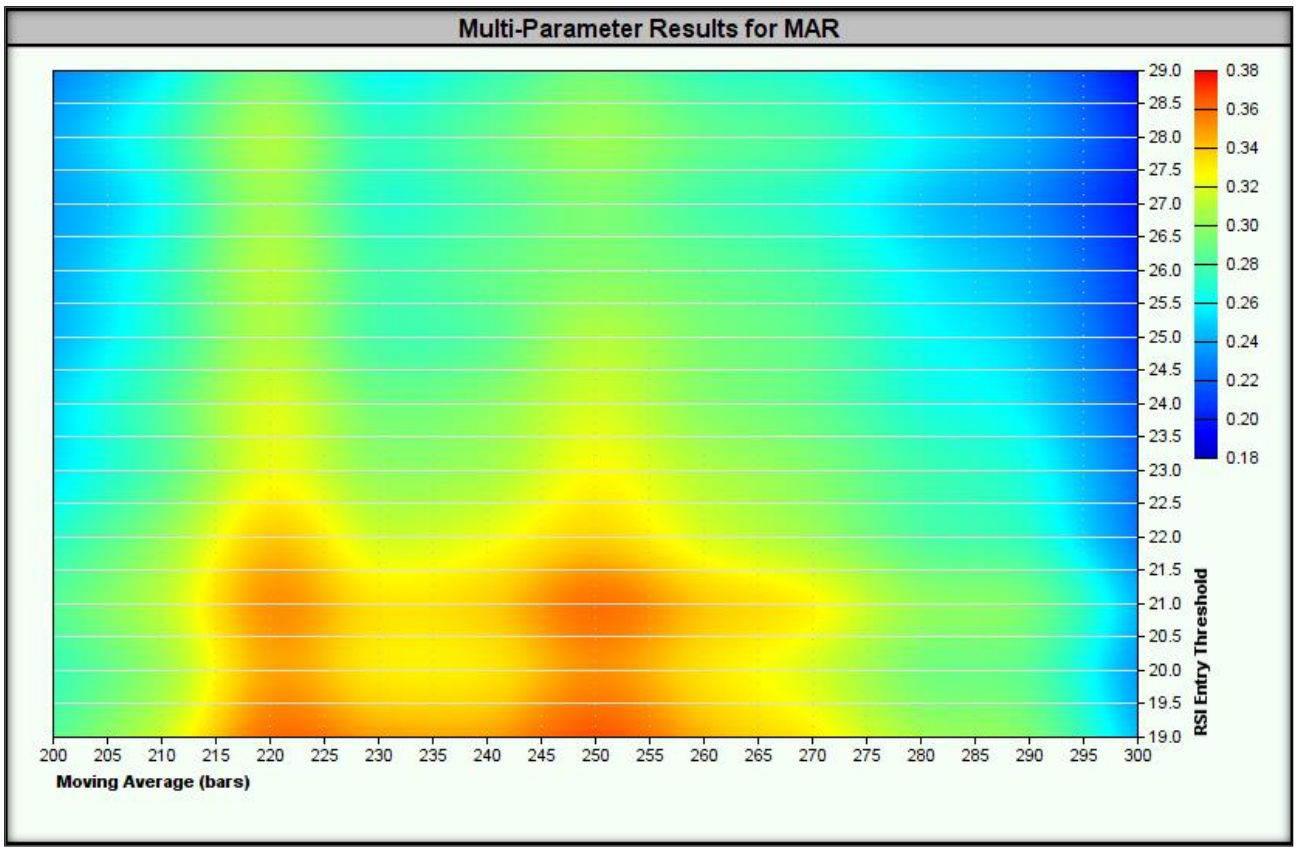
RSI (bars)


Multi-Parameter Results for MAR
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RSI Entry Threshold
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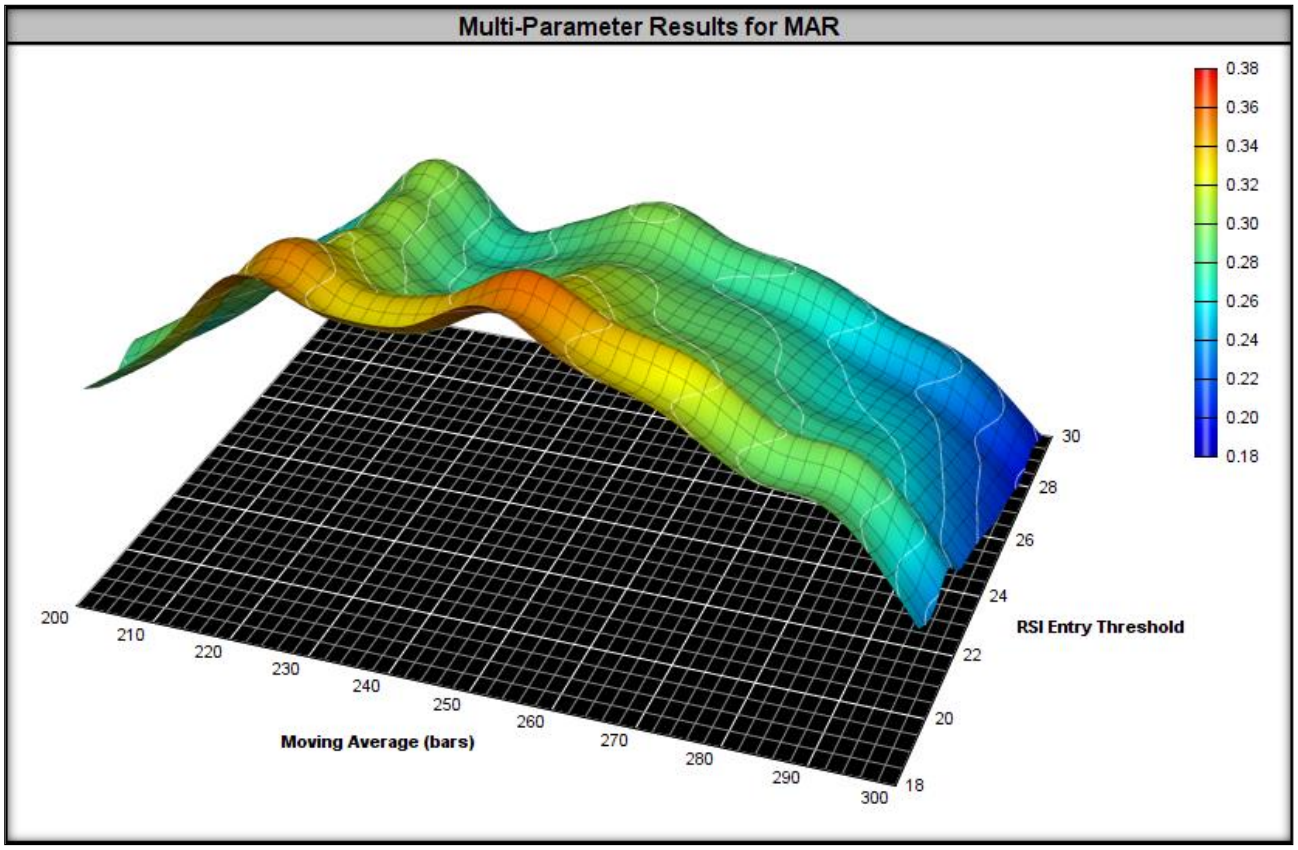
Moving Average (bars)


Multi-Parameter Results for MAR
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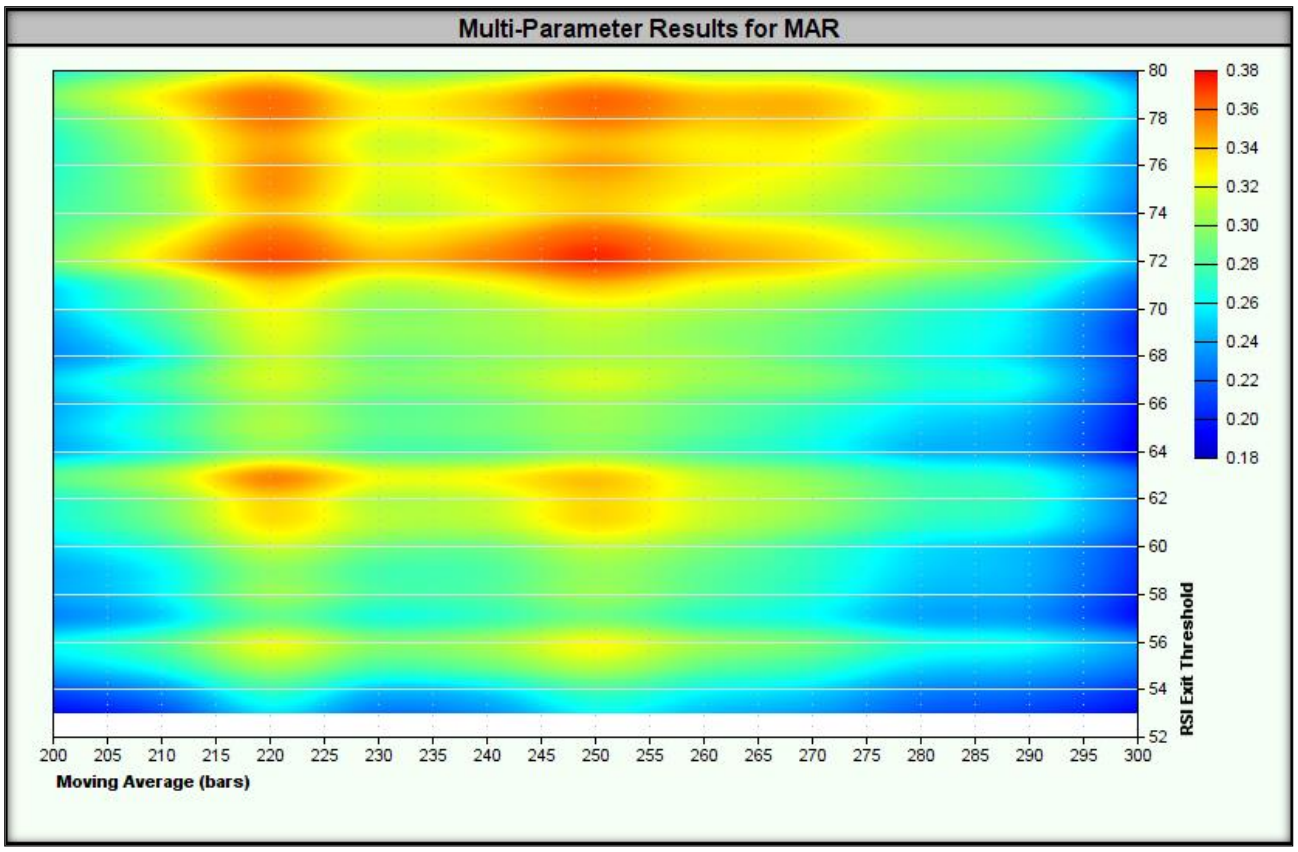
RSI Entry Threshold


Multi-Parameter Results for MAR
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RSI Exit Threshold
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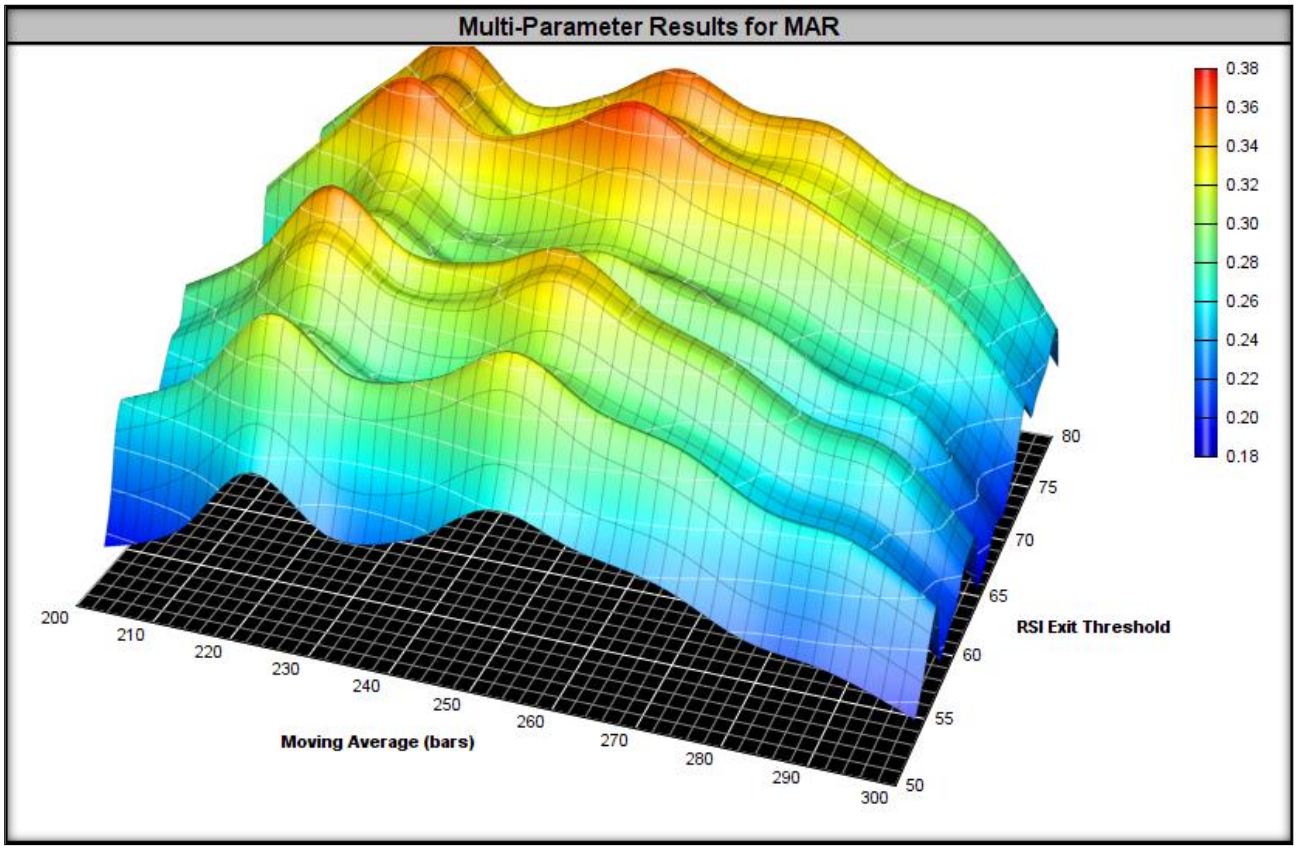
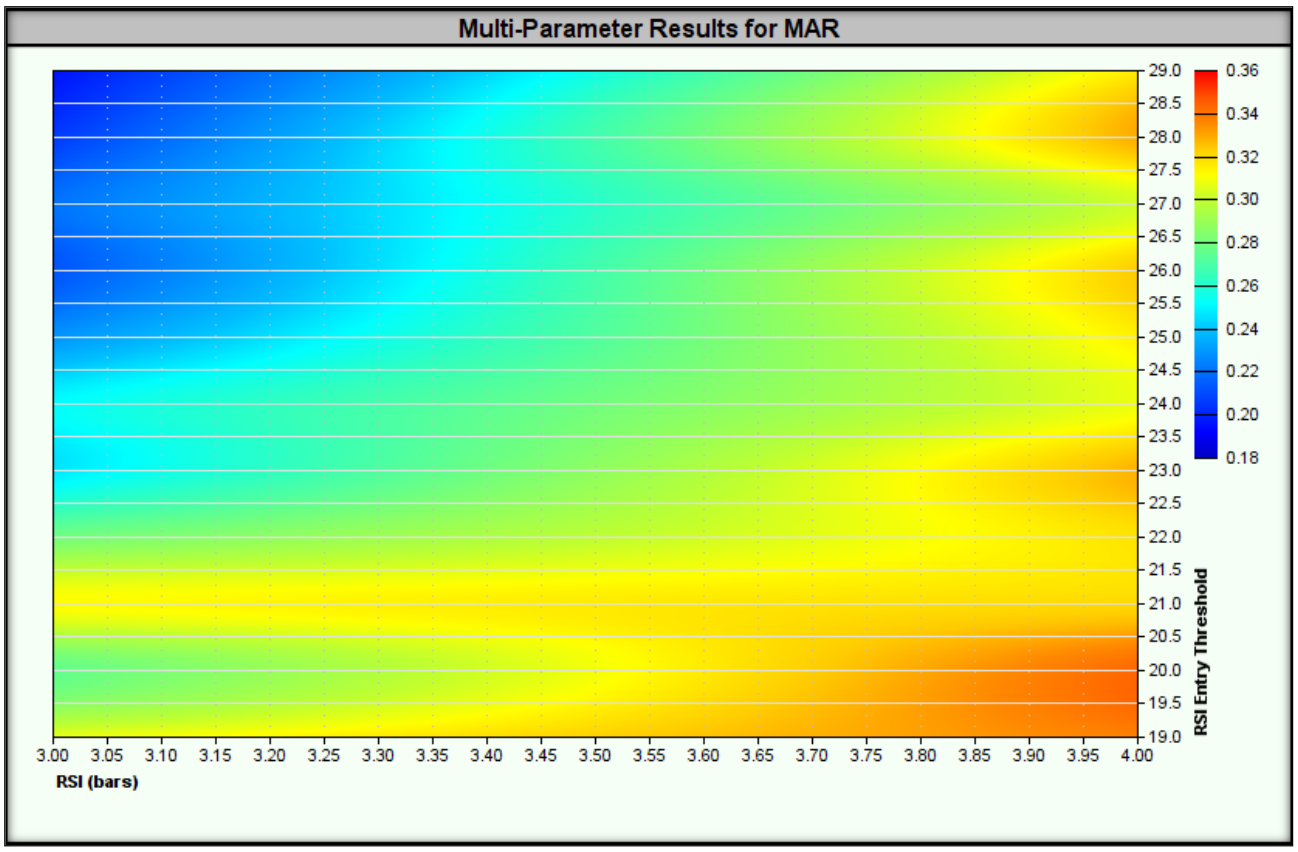
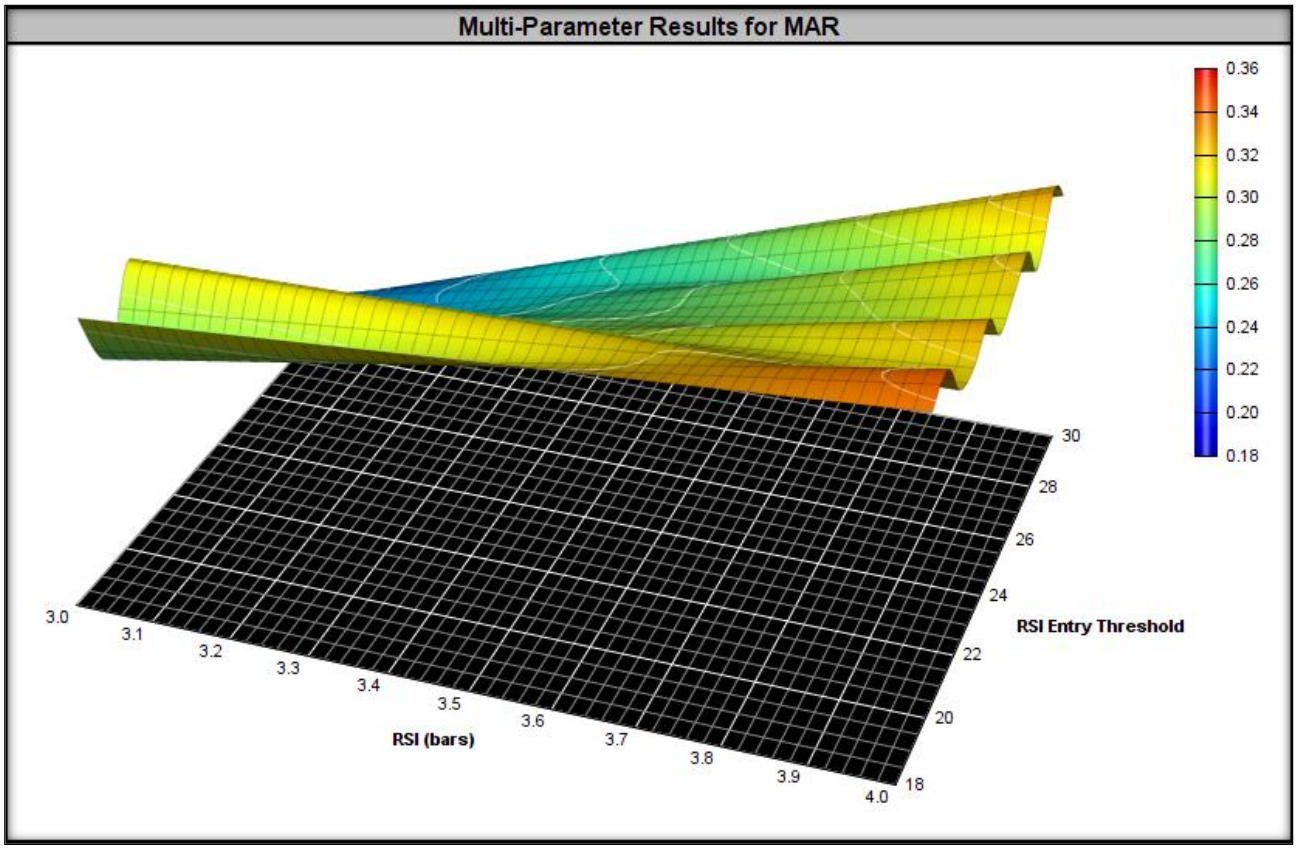
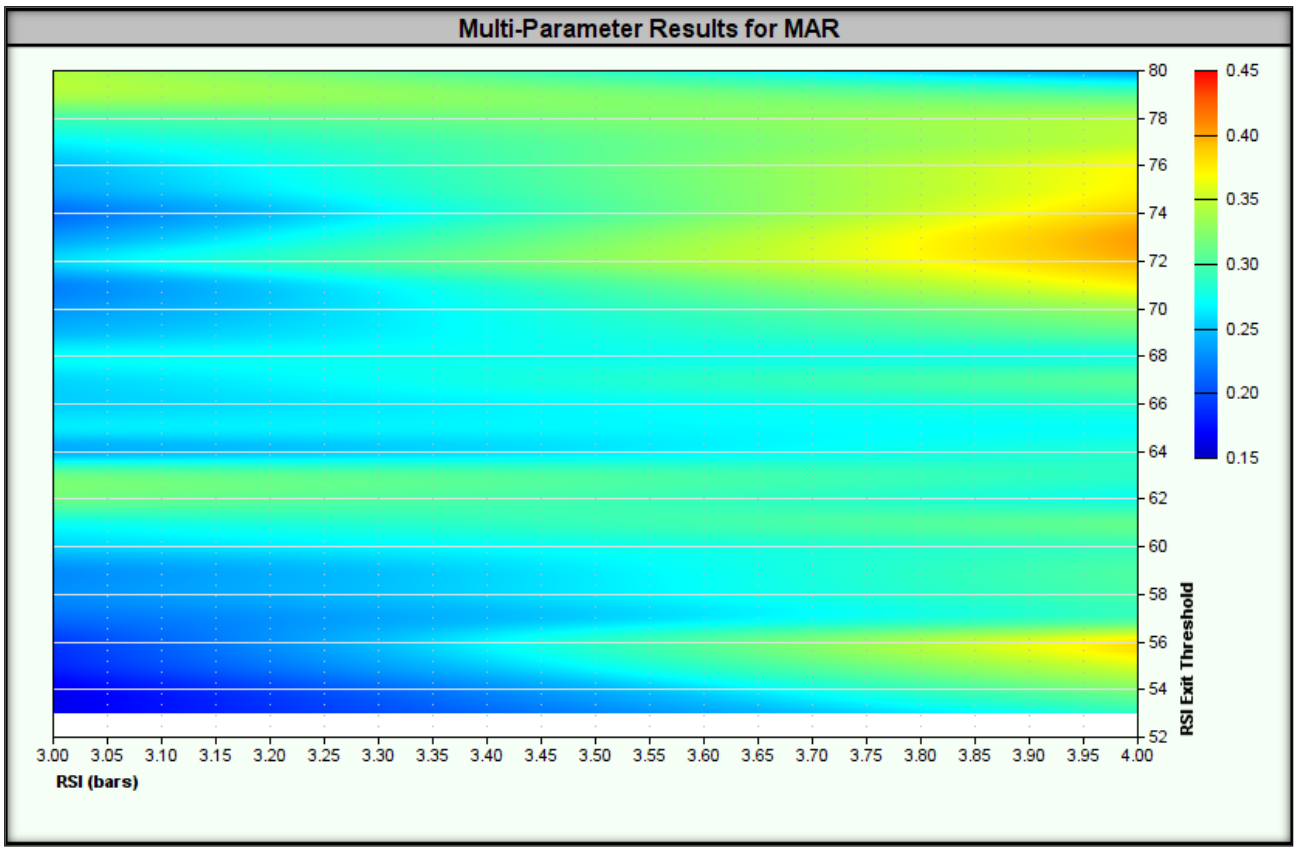
300
Moving Average (bars)

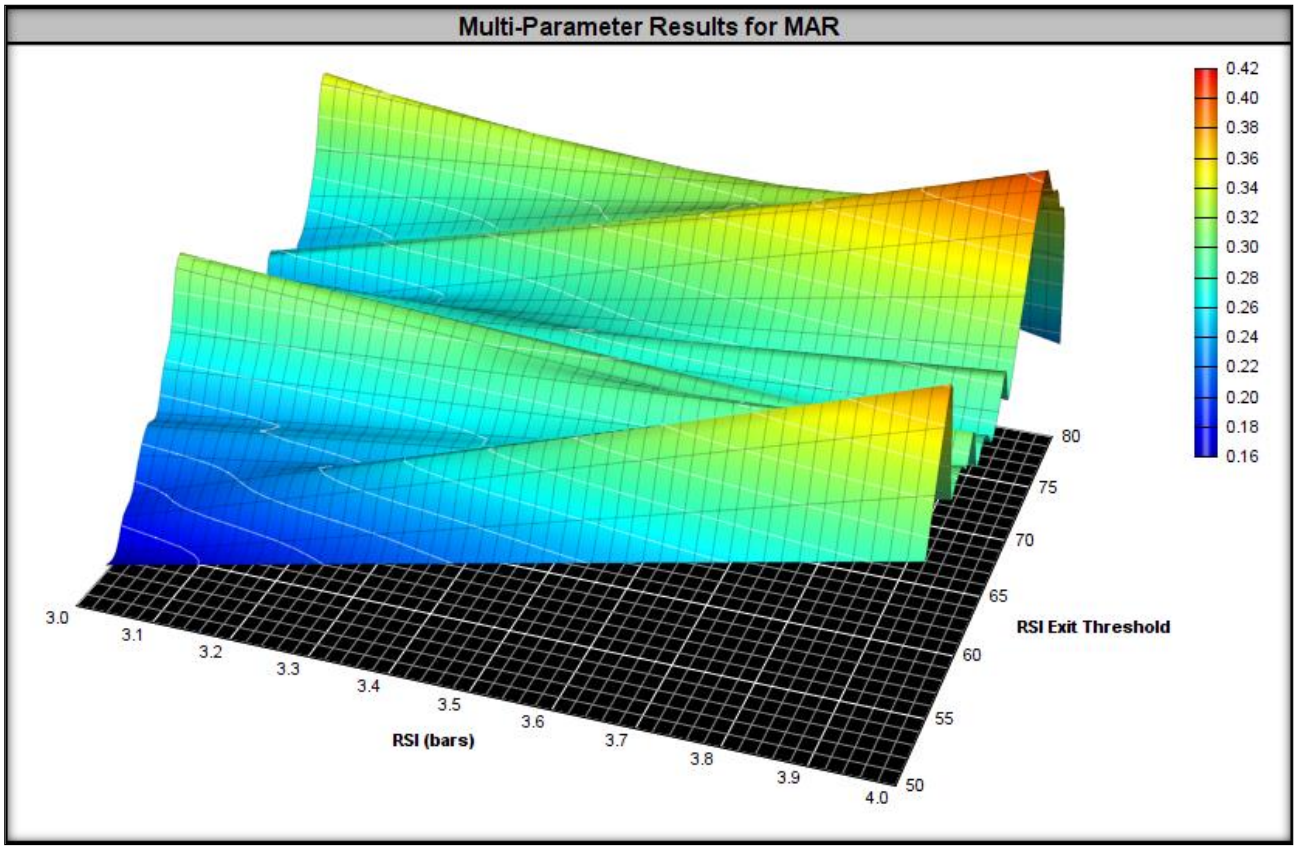


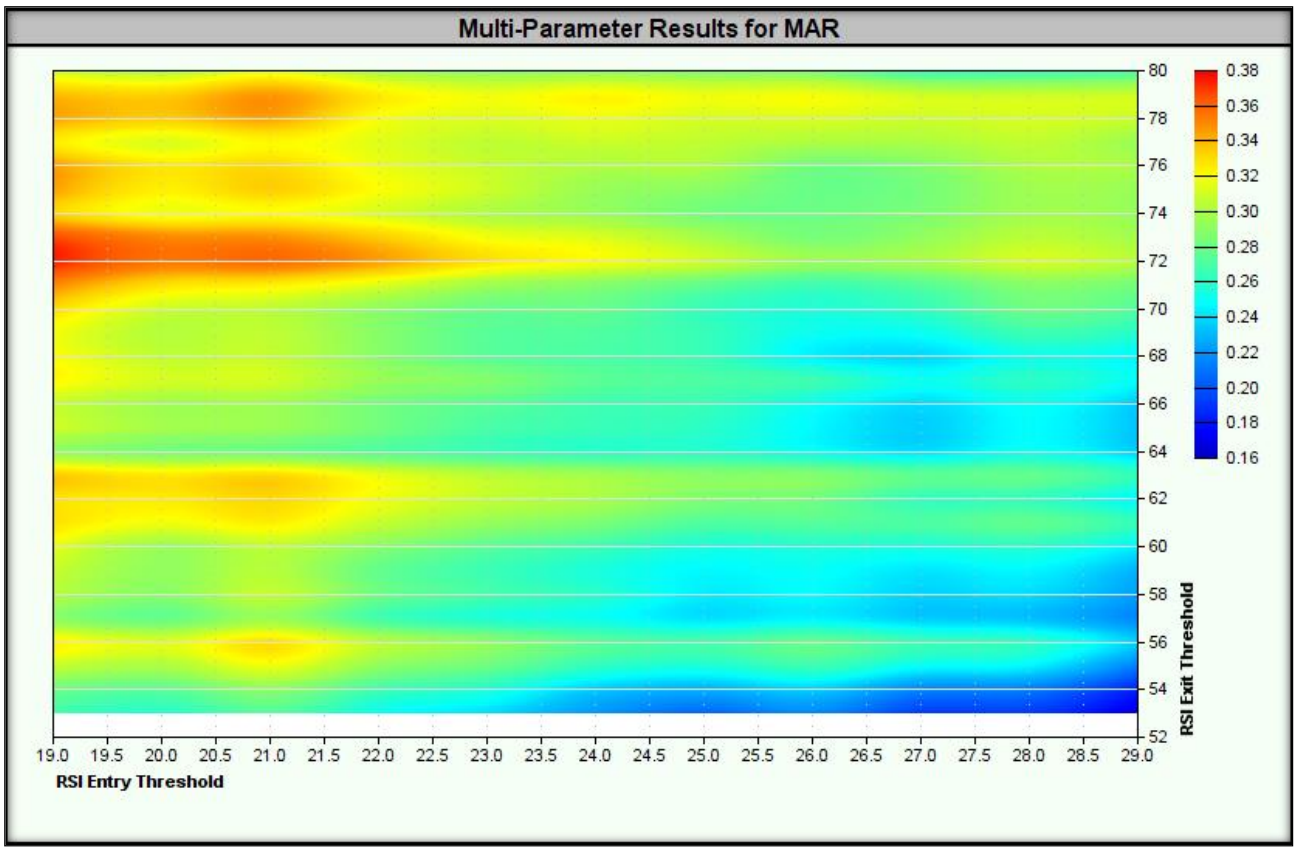


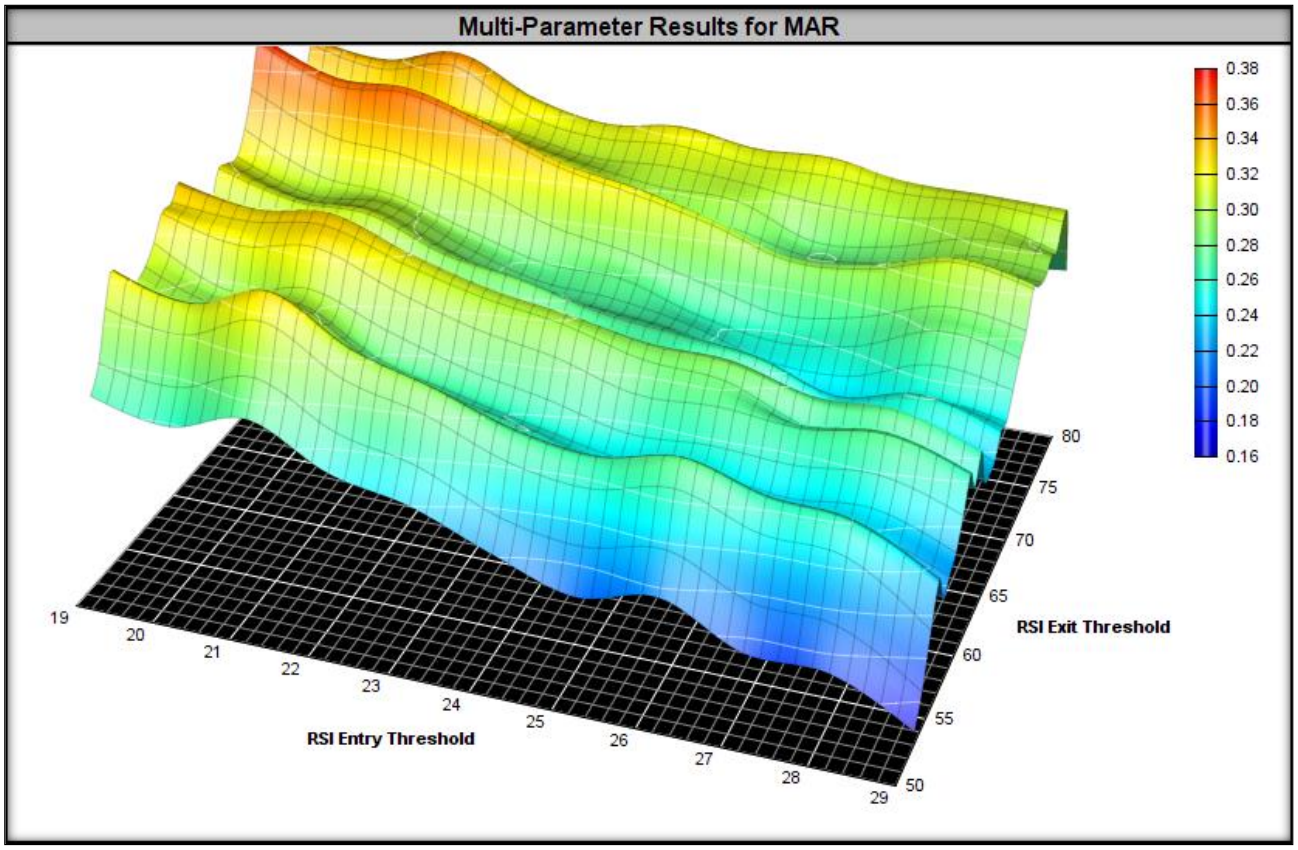
contact@tradingedge.pro
+48-698-630-421


Multi-Parameter Results for MAR
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
RSI (bars)
30
28
26
24
22
20
18
RSI Entry Threshold


Multi-Parameter Results for MAR
0.45
0.40
0.35
0.30
0.25
0.20
0.15
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
RSI Exit Threshold
3.00
3.05
3.10
3.15
3.20
3.25
3.30
3.35
3.40
3.45
3.50
3.55
3.60
3.65
3.70
3.75
3.80
3.85
3.90
3.95
4.00
RSI (bars)


Multi-Parameter Results for MAR
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
RSI (bars)
80
75
70
65
60
55
50
RSI Exit Threshold


Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
RSI Exit Threshold
19.0
19.5
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
RSI Entry Threshold


Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
19
20
21
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23
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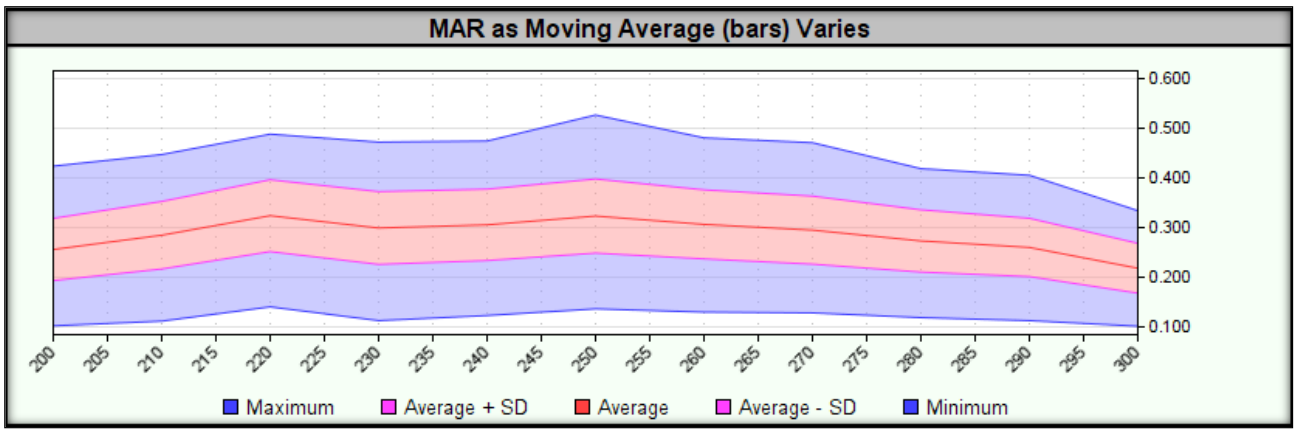
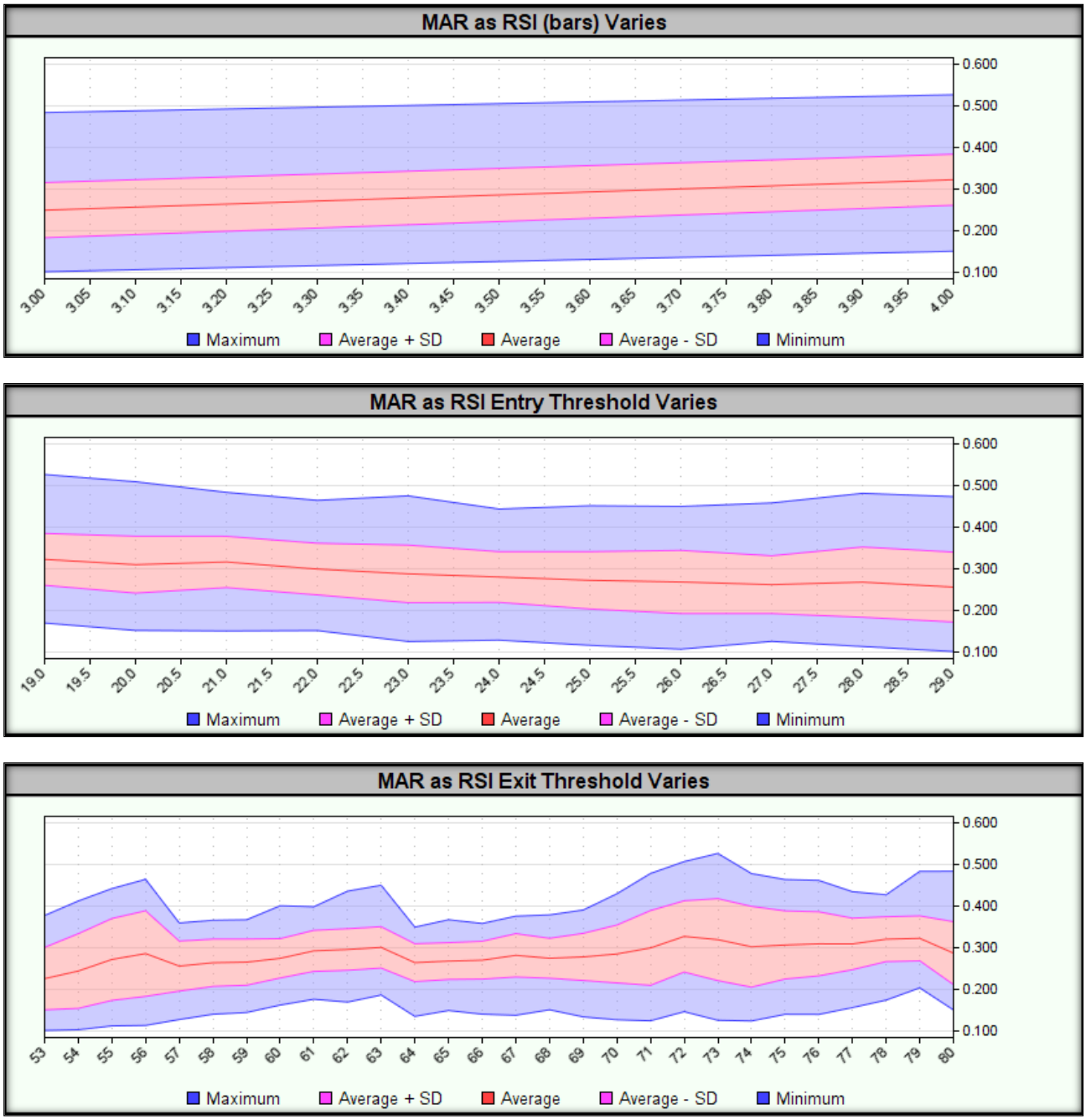
25
26
27
28
29
RSI Entry Threshold
80
75
70
65
60
55
50
RSI Exit Threshold


MAR as Moving Average (bars) Varies
0.600
0.500
0.400
0.300
0.200
0.100
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
Maximum
Average + SD
Average
Average - SD
Minimum



After passing the stability tests on **the in-sample data,** it is time perform the same on **the out-of-sample data.** For this purpose, we use **the same range of parameters** as on the in-sample data:

- **Moving average lengths (SMA):** range **200-300 days (step: 10);**
- **RSI Lengths:** Range **3-4 days (step: 1);**
- **RSI Entry Threshold:** range **19-29 (step: 1);**
- **RSI Exit Threshold (take profit):** range **53-80 (step: 1).**

The lowest MAR value of 0.01 was achieved for the following parameters:

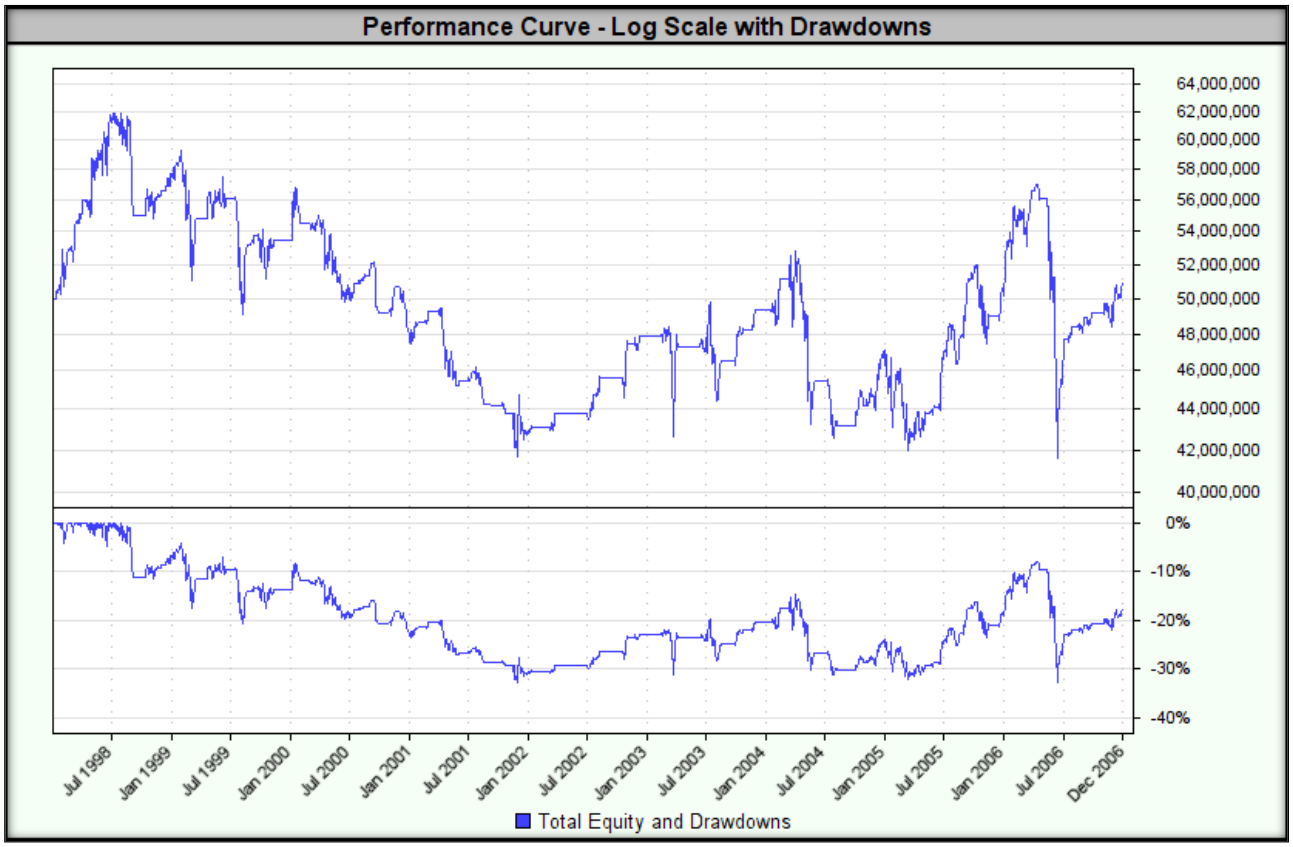
- **Length of the moving average (SMA):** 280;
- **RSI lengths:** 4;
- **RSI Entry Threshold:** 19;
- **RSI Exit Threshold (take profit):** 73.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Te...	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
5257	280	4	19	73	$50,815,946.41	0.18%	0.01	0.08	0.02	32.8%	101.0	353
3409	250	4	19	73	$50,788,750.70	0.17%	0.01	0.08	0.02	29.2%	89.9	339
4025	260	4	19	73	$52,028,091.08	0.44%	0.01	0.10	0.05	30.6%	91.7	339
4641	270	4	19	73	$52,134,305.14	0.47%	0.01	0.10	0.05	32.1%	101.0	349
3408	250	4	19	72	$51,952,742.70	0.43%	0.01	0.10	0.04	28.8%	89.7	342
5258	280	4	19	74	$52,832,869.10	0.61%	0.02	0.11	0.07	34.0%	101.0	349
5256	280	4	19	72	$52,702,434.96	0.59%	0.02	0.11	0.07	32.2%	101.0	356
4031	260	4	19	79	$52,940,395.43	0.64%	0.02	0.12	0.07	34.6%	91.6	322
3415	250	4	19	79	$53,099,609.96	0.67%	0.02	0.12	0.07	33.6%	90.0	323
5260	280	4	19	76	$53,644,322.04	0.79%	0.02	0.13	0.08	33.0%	100.4	345
4640	270	4	19	72	$53,681,359.10	0.79%	0.03	0.13	0.09	31.7%	92.2	352

Below is a graph of the equity curve for **the strategy with the lowest MAR.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



The highest MAR value of 0.53 was achieved for the following parameters:

- **Length of the moving average (SMA):** 220;
- **RSI lengths:** 3;
- **RSI Entry Threshold:** 22;
- **RSI Exit Threshold (take profit):** 59.

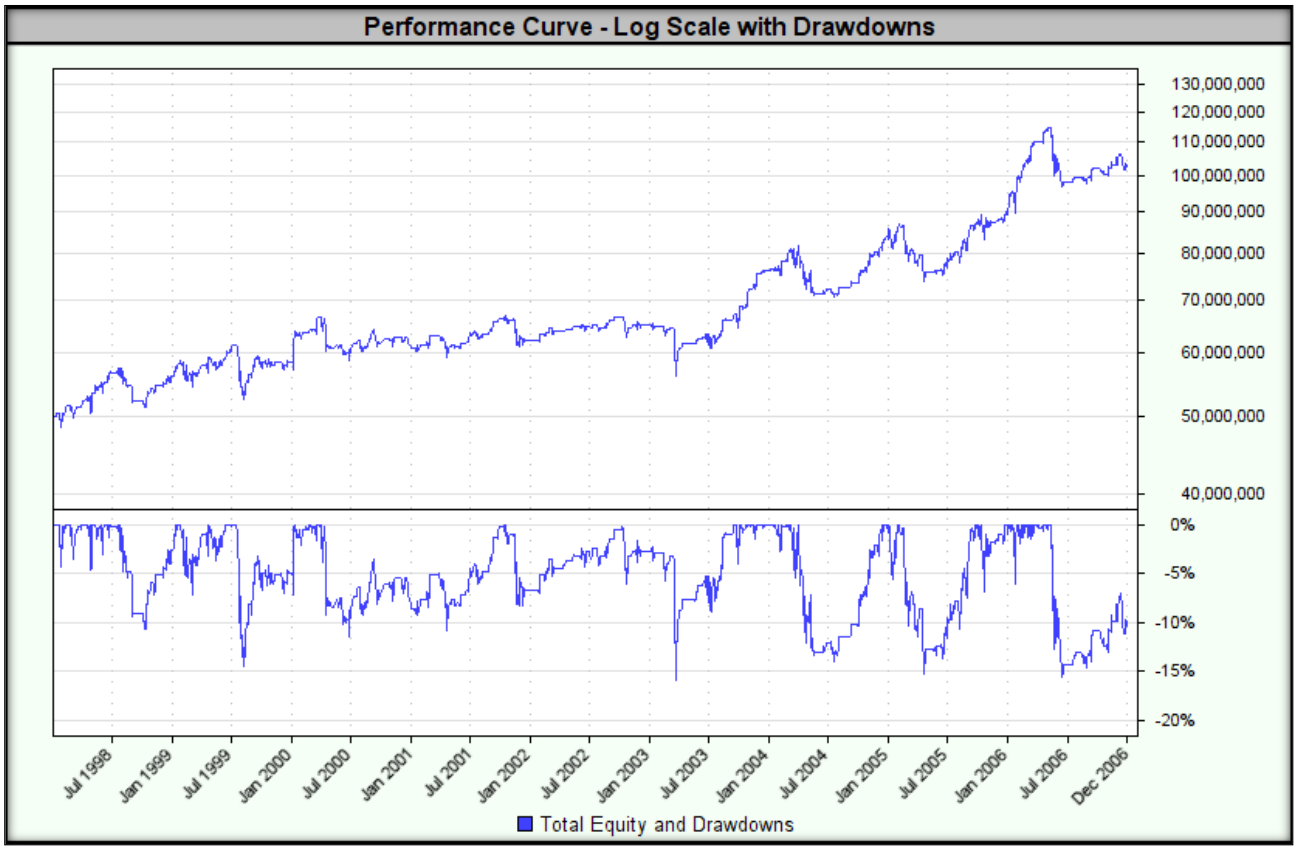
The highest MAR value was accompanied by **a drawdown of 15.9%.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Te...	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
1323	220	3	22	59	$102,830,175.94	8.35%	0.53	0.70	1.54	15.9%	22.9	844
1335	220	3	22	71	$133,246,784.18	11.52%	0.51	0.77	1.19	22.4%	29.7	771
1326	220	3	22	62	$111,230,482.78	9.30%	0.51	0.74	1.33	18.1%	40.3	833
6263	300	3	22	71	$140,426,539.69	12.17%	0.50	0.82	1.21	24.1%	42.9	815
1331	220	3	22	67	$127,830,070.47	11.00%	0.50	0.80	1.42	21.9%	17.8	805
3183	250	3	22	71	$127,088,871.41	10.93%	0.50	0.76	1.24	22.1%	39.5	787
710	210	3	22	62	$106,365,273.89	8.76%	0.49	0.71	1.16	17.8%	40.6	817
1333	220	3	22	69	$127,643,414.73	10.99%	0.49	0.76	1.23	22.4%	18.7	783
2567	240	3	22	71	$126,018,854.42	10.83%	0.49	0.75	1.23	22.1%	39.7	787
1334	220	3	22	70	$126,216,210.52	10.85%	0.48	0.74	1.23	22.4%	39.3	775
1267	220	3	20	59	$96,388,919.34	7.57%	0.48	0.67	1.43	15.7%	17.6	734

Below is a graph of the equity curve for **the strategy with the highest MAR.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



For all combinations of tested parameter ranges, **the highest drawdown was 40.6%.**

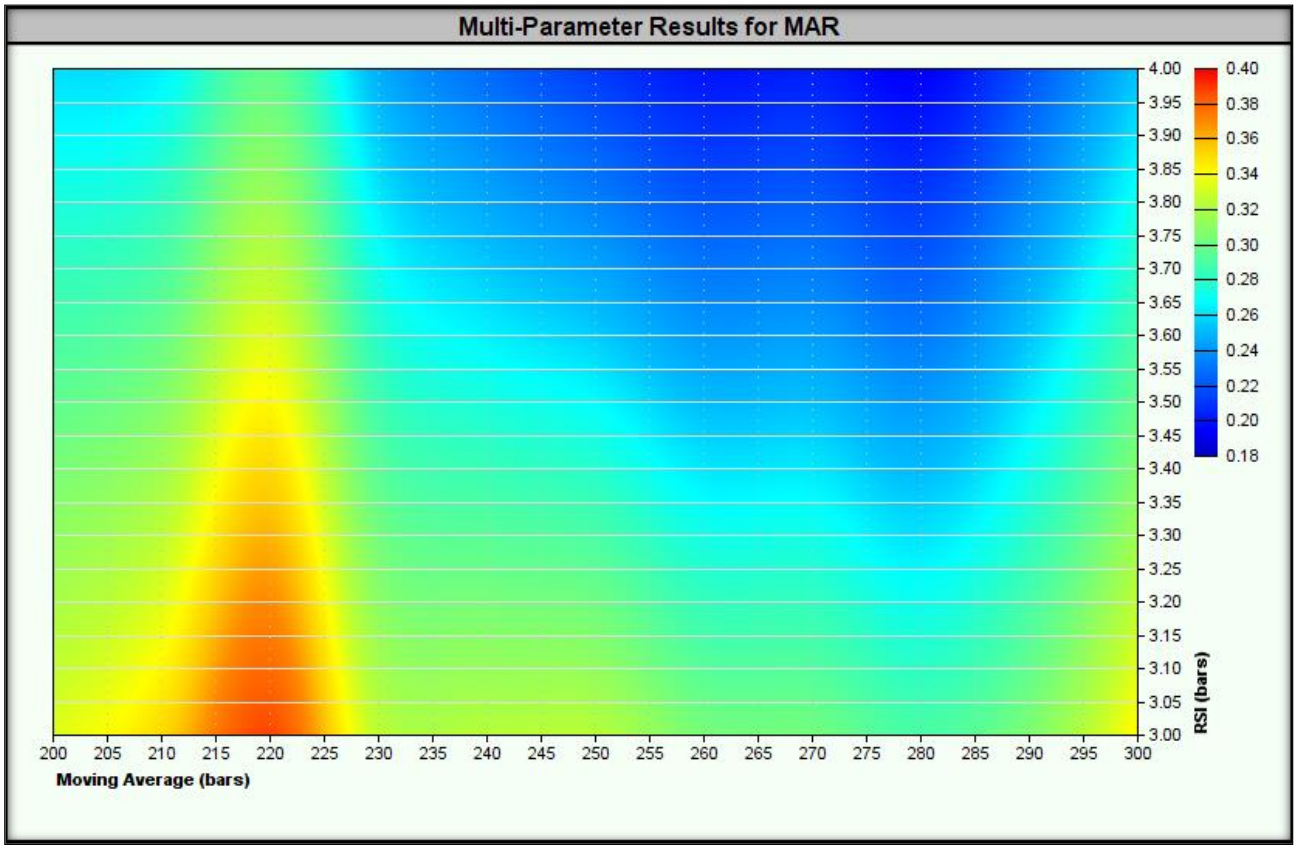
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

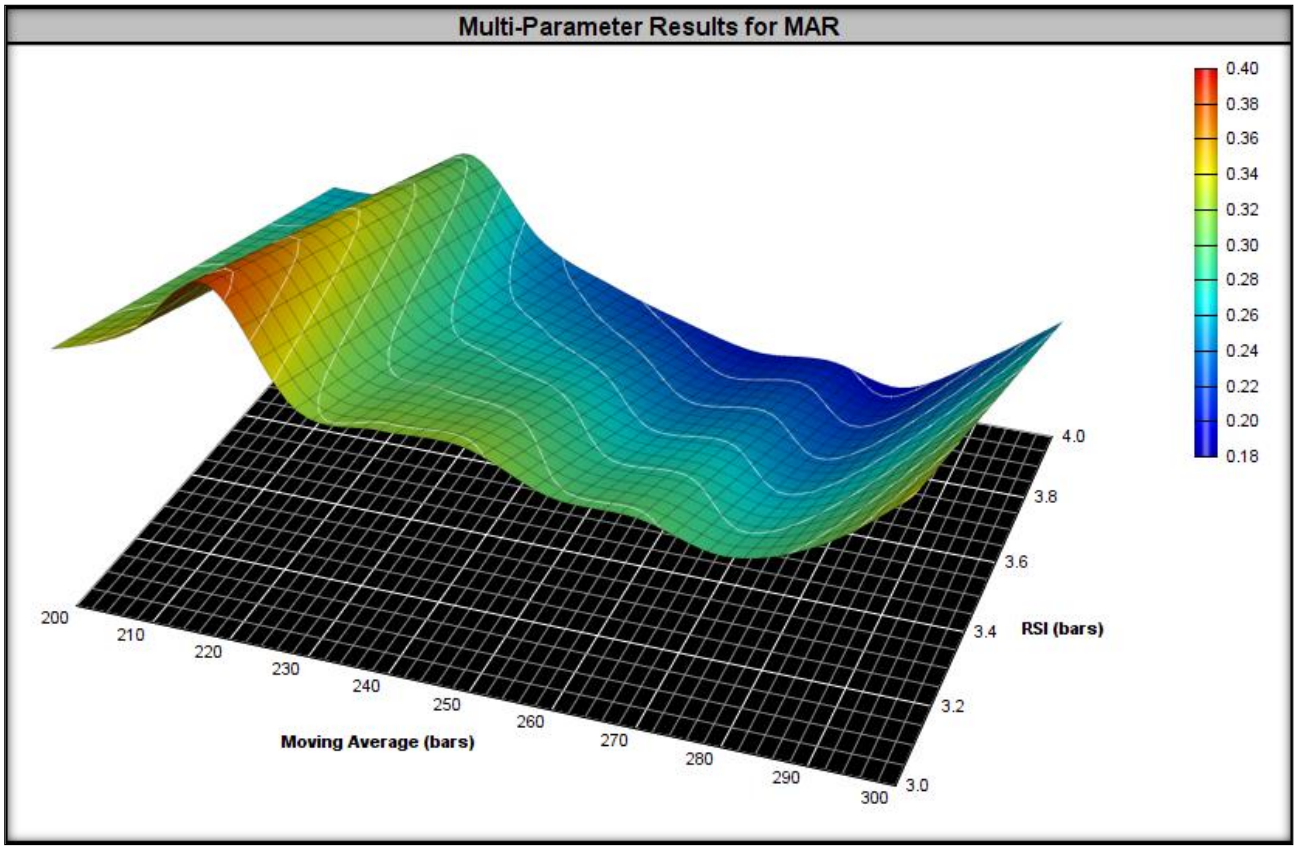
Te...	Moving Average (bars)	RSI (bars)	RSI Entry Threshold	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
5208	280	3	28	80	$118,716,730.78	10.10%	0.25	0.55	0.80	40.6%	43.1	858
5236	280	3	29	80	$127,813,692.25	11.00%	0.27	0.59	0.78	40.6%	38.5	881
5824	290	3	28	80	$123,507,597.43	10.58%	0.26	0.57	0.85	40.6%	44.8	855
6440	300	3	28	80	$135,807,010.40	11.75%	0.29	0.62	0.90	40.6%	45.3	854
5852	290	3	29	80	$133,220,896.96	11.52%	0.28	0.61	0.85	40.6%	44.2	880
5823	290	3	28	79	$118,193,144.67	10.04%	0.25	0.56	0.84	40.6%	44.6	876
5851	290	3	29	79	$127,620,379.33	10.98%	0.27	0.60	0.84	40.6%	44.0	903
6467	300	3	29	79	$142,197,043.99	12.33%	0.30	0.65	0.93	40.6%	44.2	903
5235	280	3	29	79	$122,455,389.27	10.48%	0.26	0.58	0.74	40.6%	38.2	904
6439	300	3	28	79	$131,576,618.98	11.36%	0.28	0.61	0.91	40.6%	45.0	876
6468	300	3	29	80	$146,678,227.20	12.72%	0.31	0.65	0.92	40.6%	44.6	879

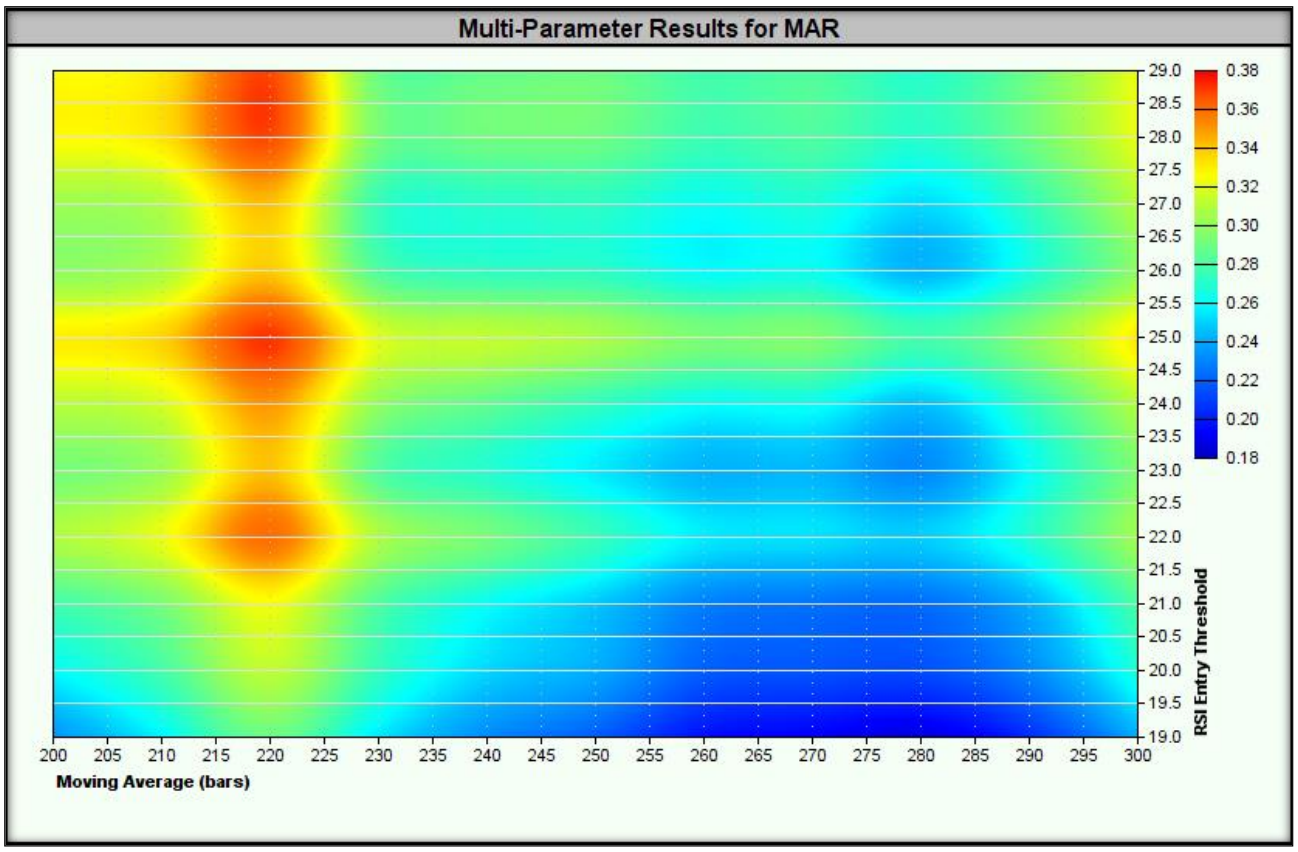
In summary, the strategy **passed the stability test** over a wide range of optimized parameters on out-of-sample data because:

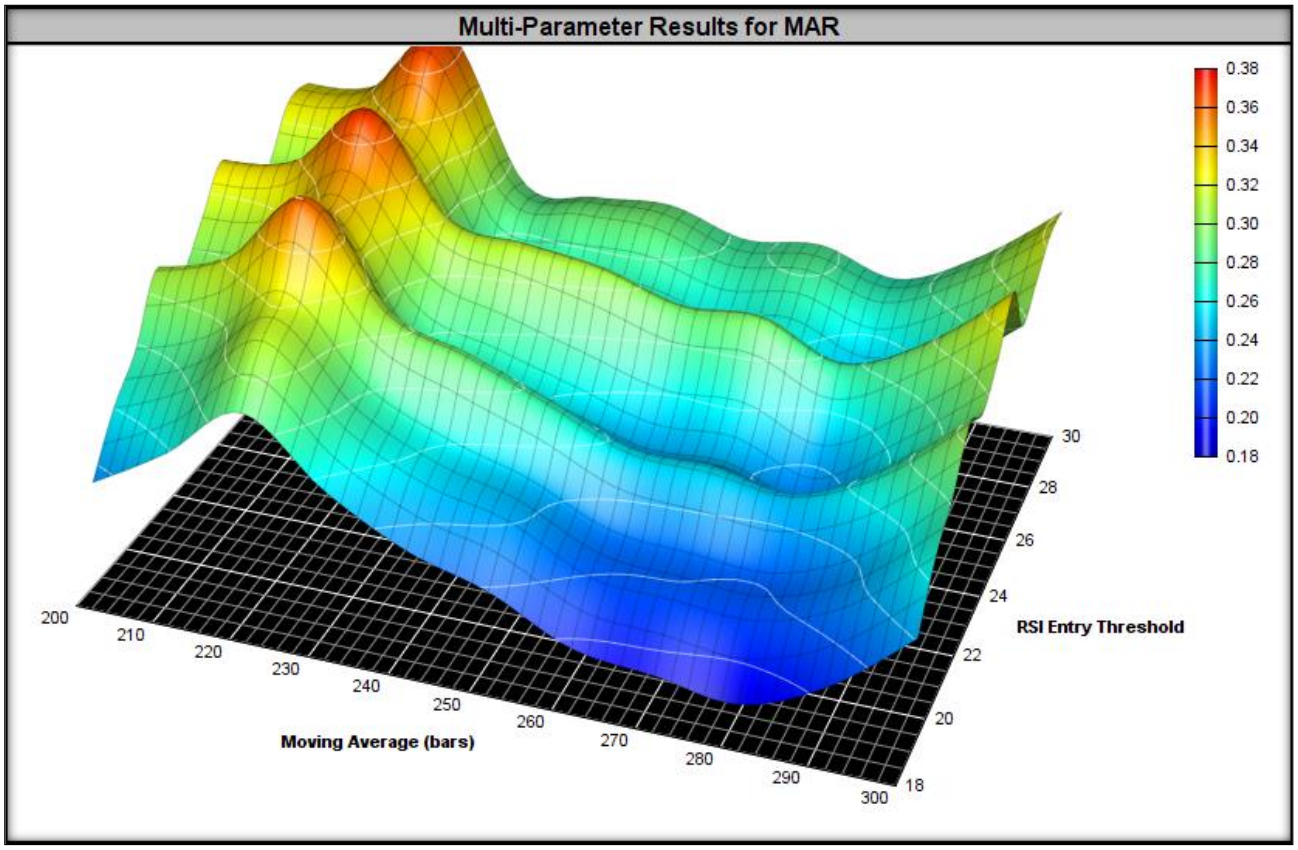
- **MAR value** – which indicates the stability of the strategy in various market conditions.
- **Maximum drawdown on out-of-sample data did not exceed 150% of the maximum drawdown value on in-sample data (40.6% vs. 55.7%)** – which means an acceptable risk of capital drawdown.
- **The decrease in the maximum MAR value on the out-of-sample data was less than 50% relative to the in-sample test results (0.53 vs. 0.53)** – indicating that the strategy can perform well in a variety of market conditions.

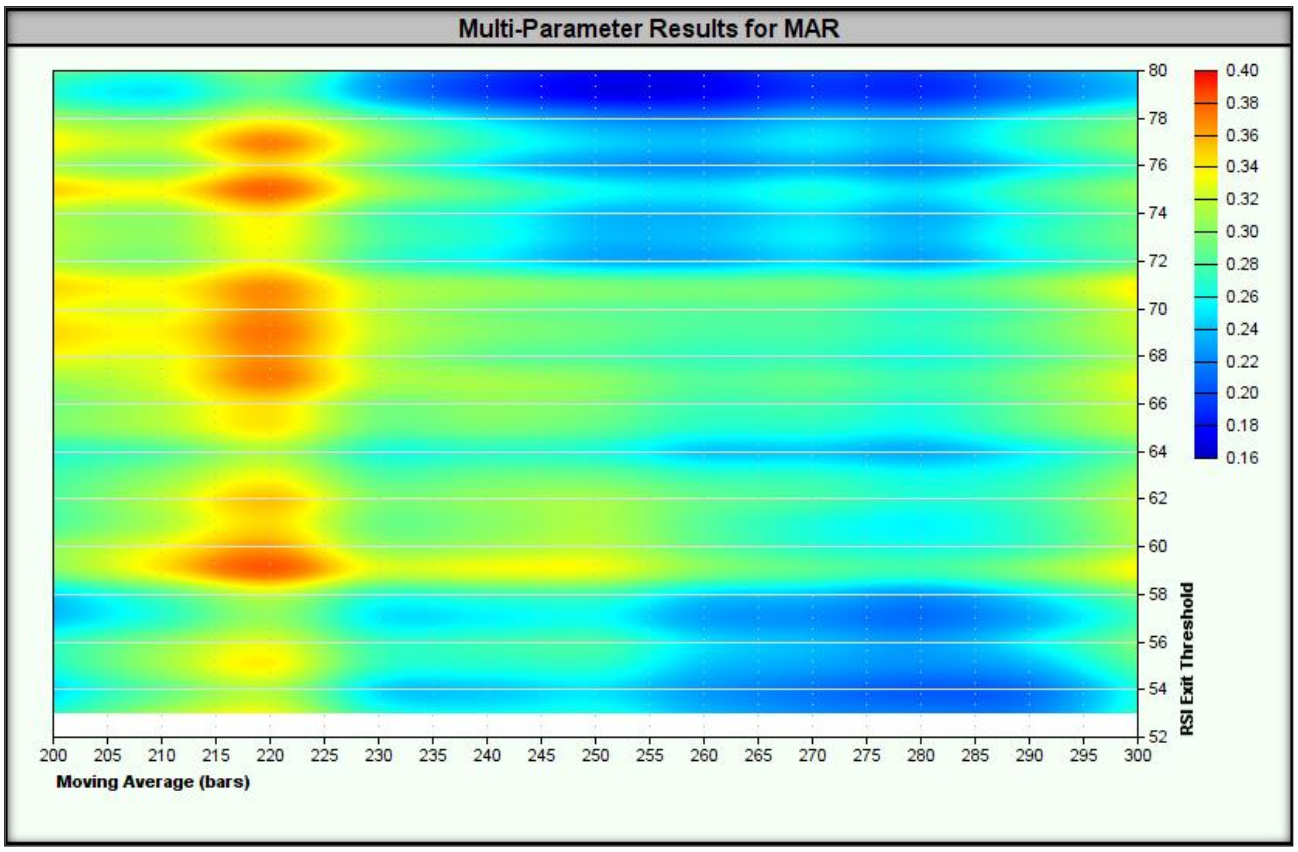
Heatmaps for the tested ranges are presented below.

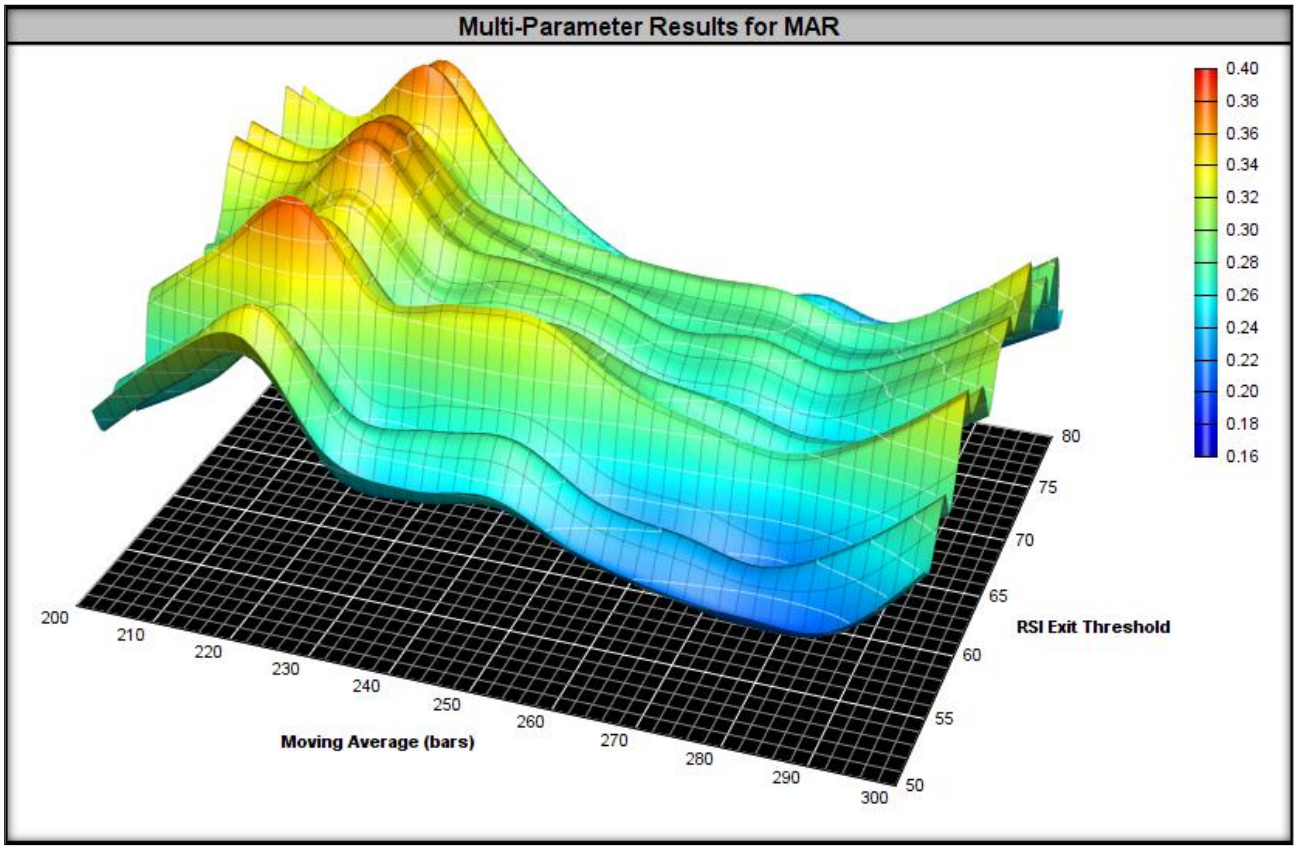


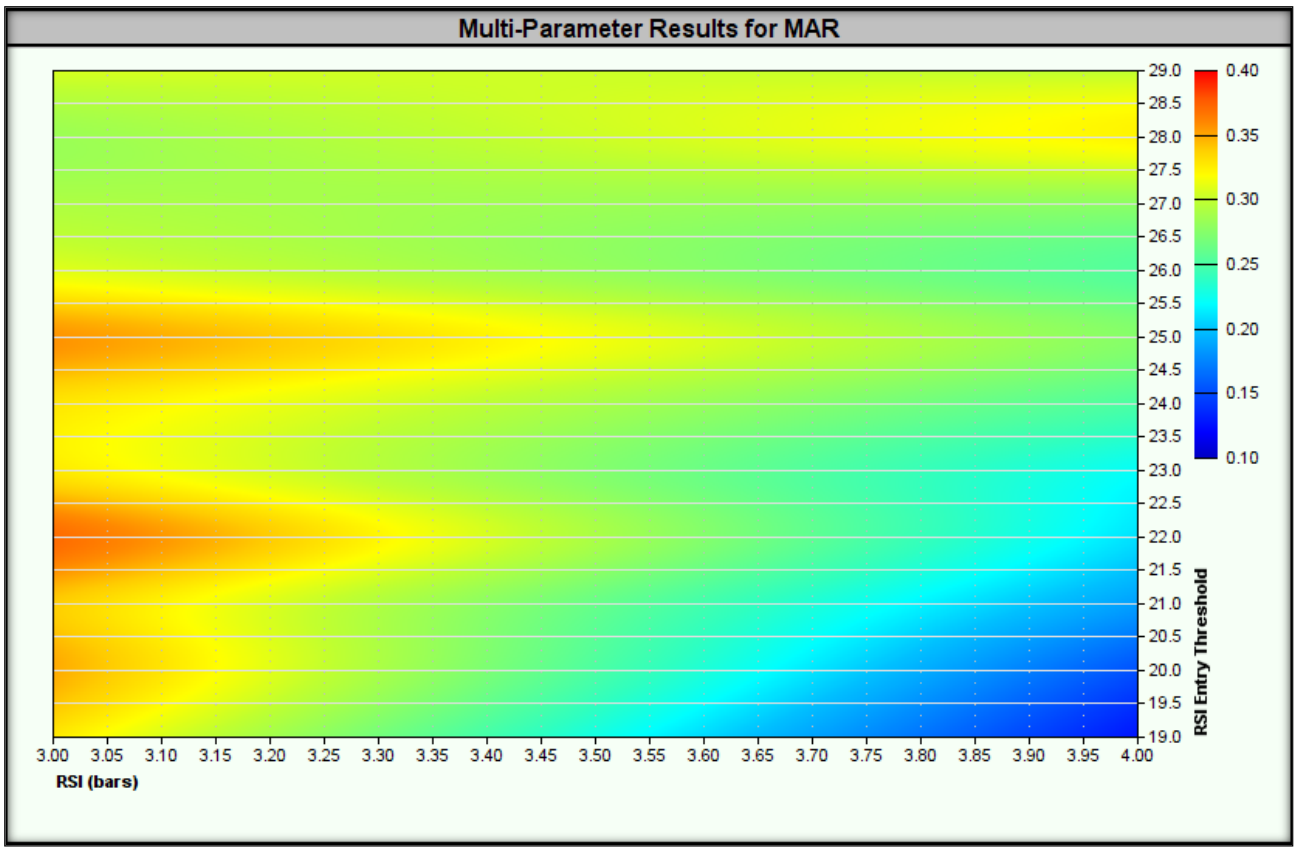

Multi-Parameter Results for MAR
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
200
210
220
230
240
250
260
270
280
290
300
Moving Average (bars)
4.0
3.8
3.6
3.4
3.2
3.0
RSI (bars)

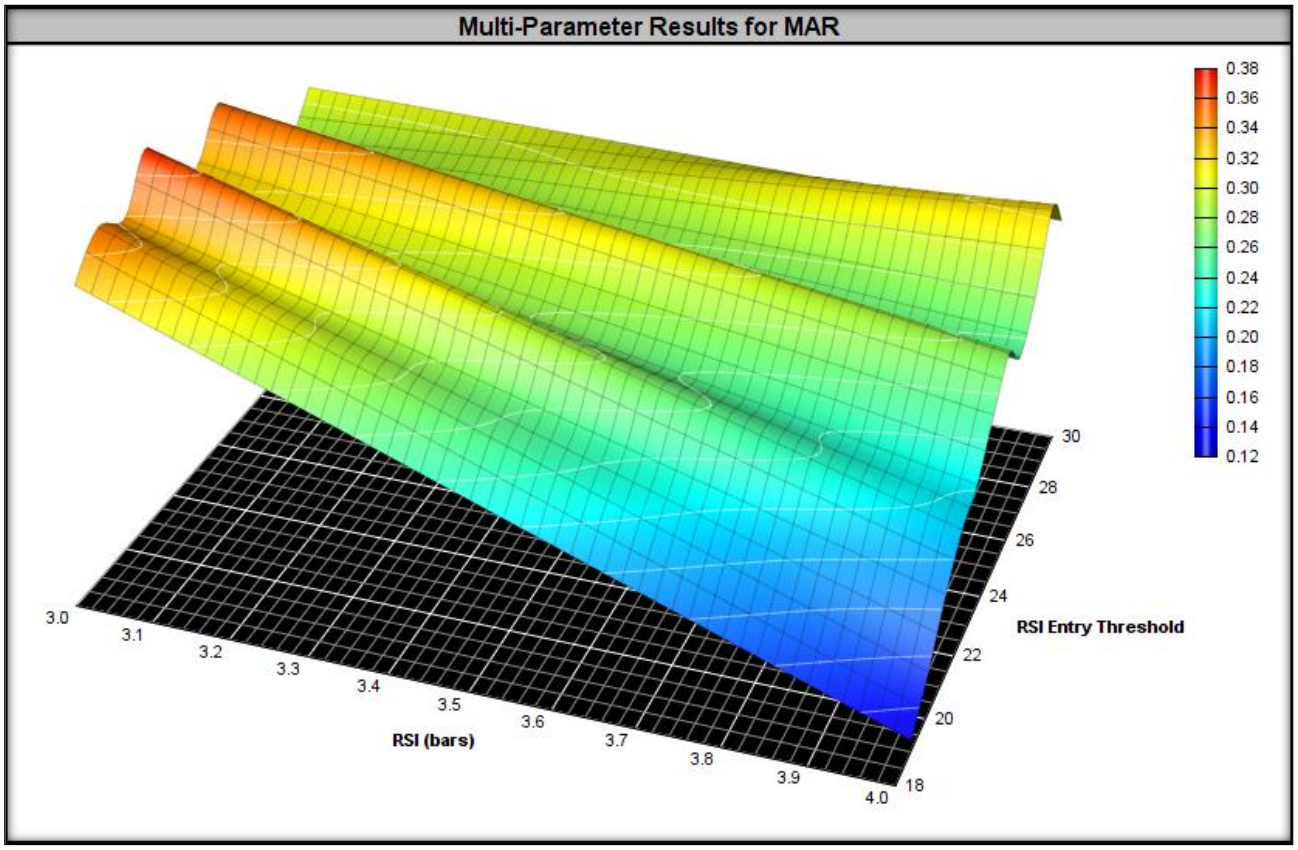

Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
RSI Entry Threshold
200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300
Moving Average (bars)

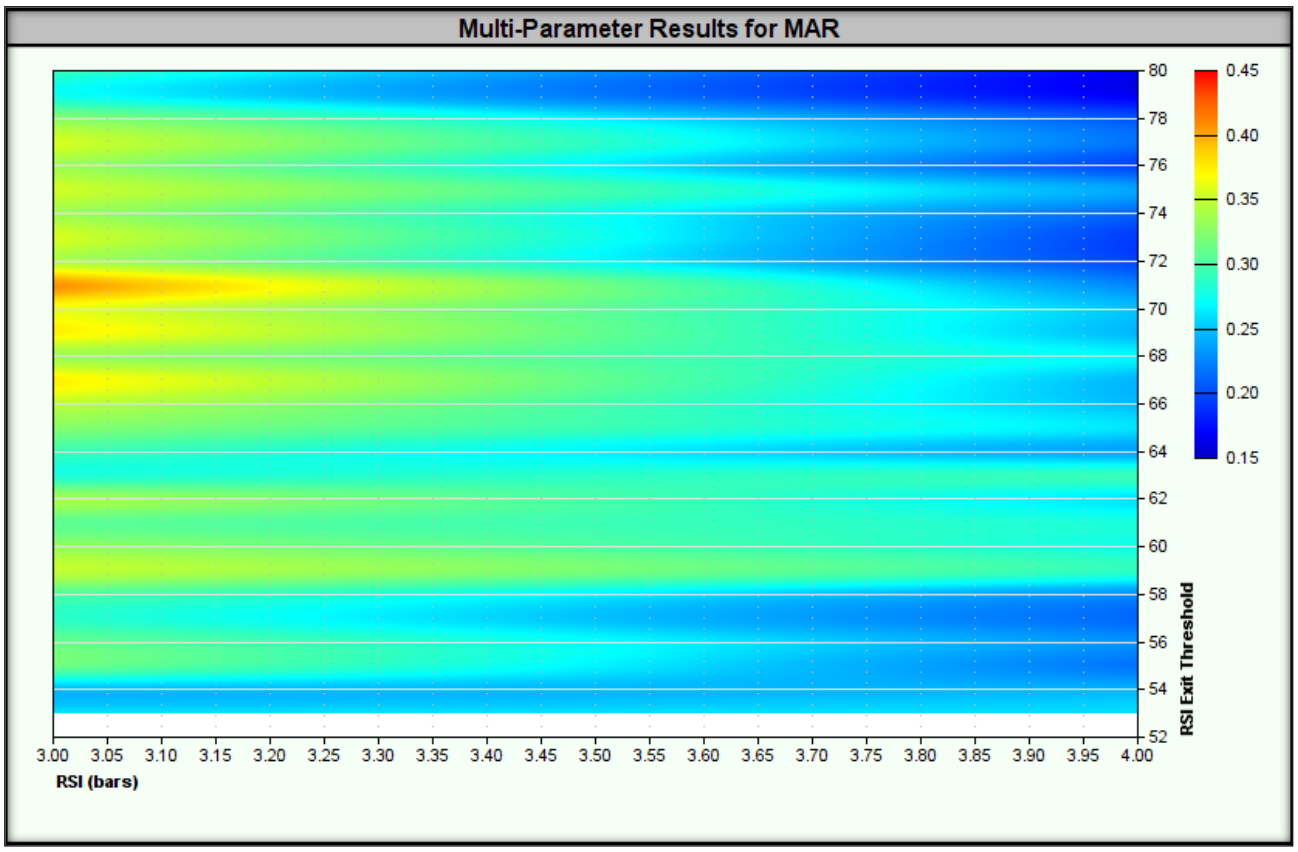

Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
200
210
220
230
240
250
260
270
280
290
300
Moving Average (bars)
18
20
22
24
26
28
30
RSI Entry Threshold

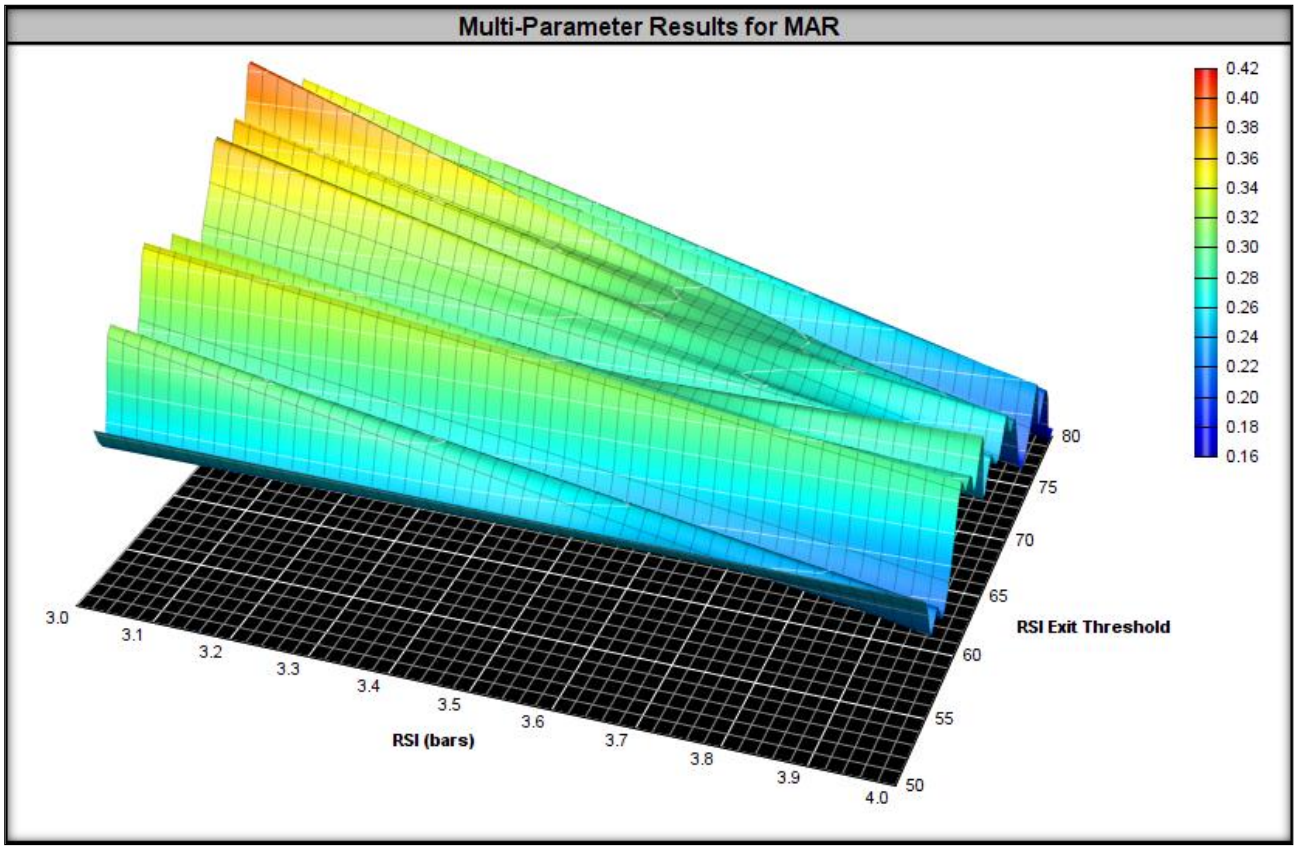

Multi-Parameter Results for MAR
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
RSI Exit Threshold
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
Moving Average (bars)

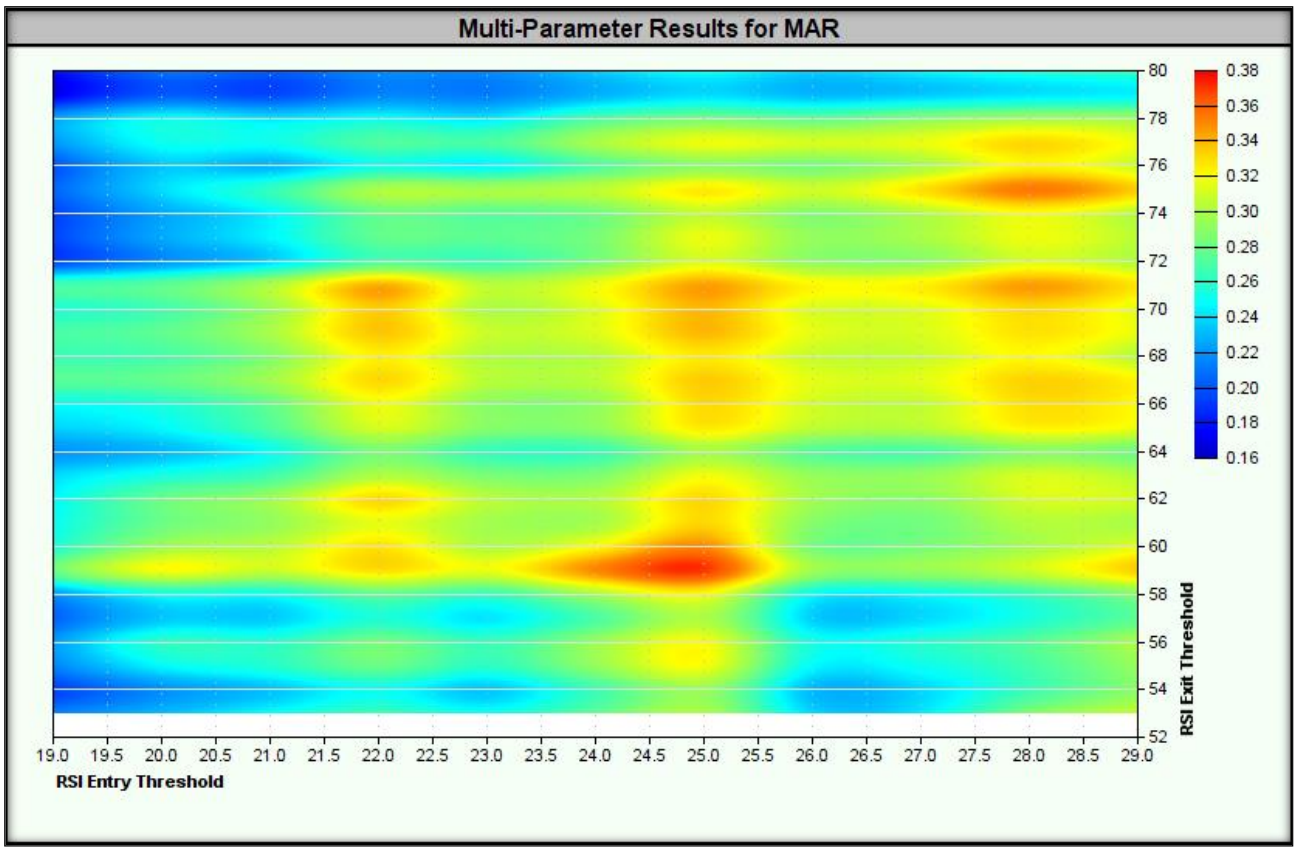

Multi-Parameter Results for MAR
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
200
210
220
230
240
250
260
270
280
290
300
Moving Average (bars)
80
75
70
65
60
55
50
RSI Exit Threshold

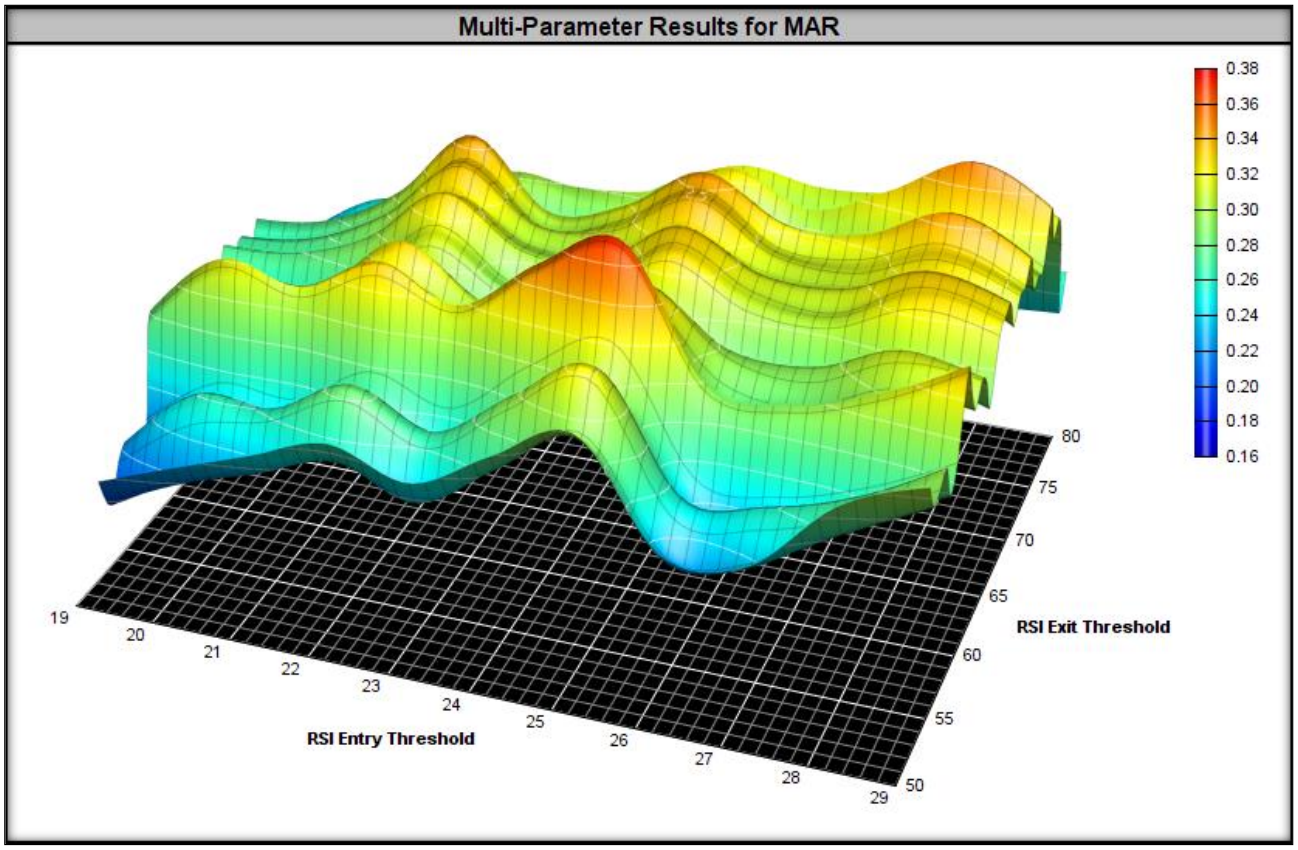

Multi-Parameter Results for MAR
0.40
0.35
0.30
0.25
0.20
0.15
0.10
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
RSI Entry Threshold
3.00
3.05
3.10
3.15
3.20
3.25
3.30
3.35
3.40
3.45
3.50
3.55
3.60
3.65
3.70
3.75
3.80
3.85
3.90
3.95
4.00
RSI (bars)

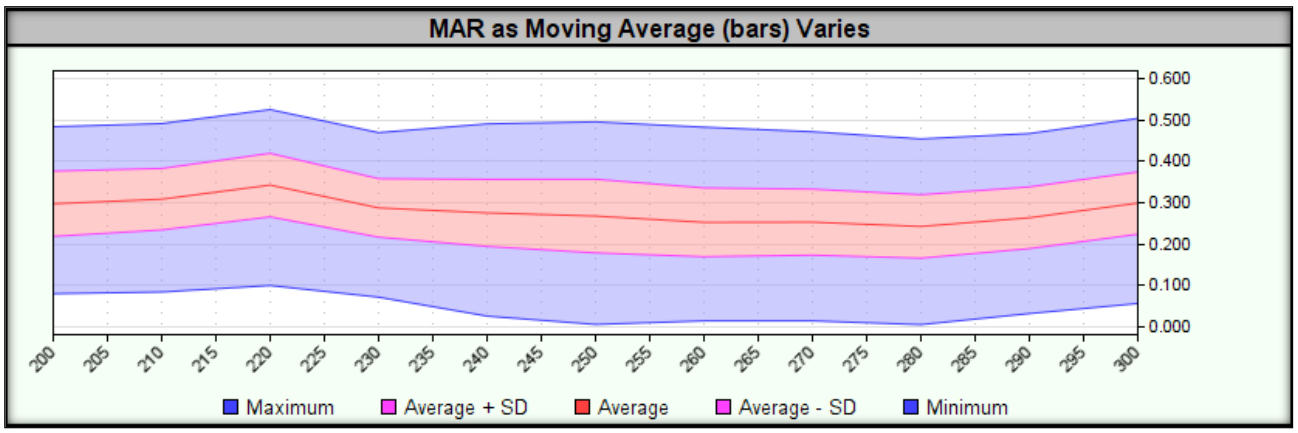

Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
RSI (bars)
30
28
26
24
22
20
18
RSI Entry Threshold

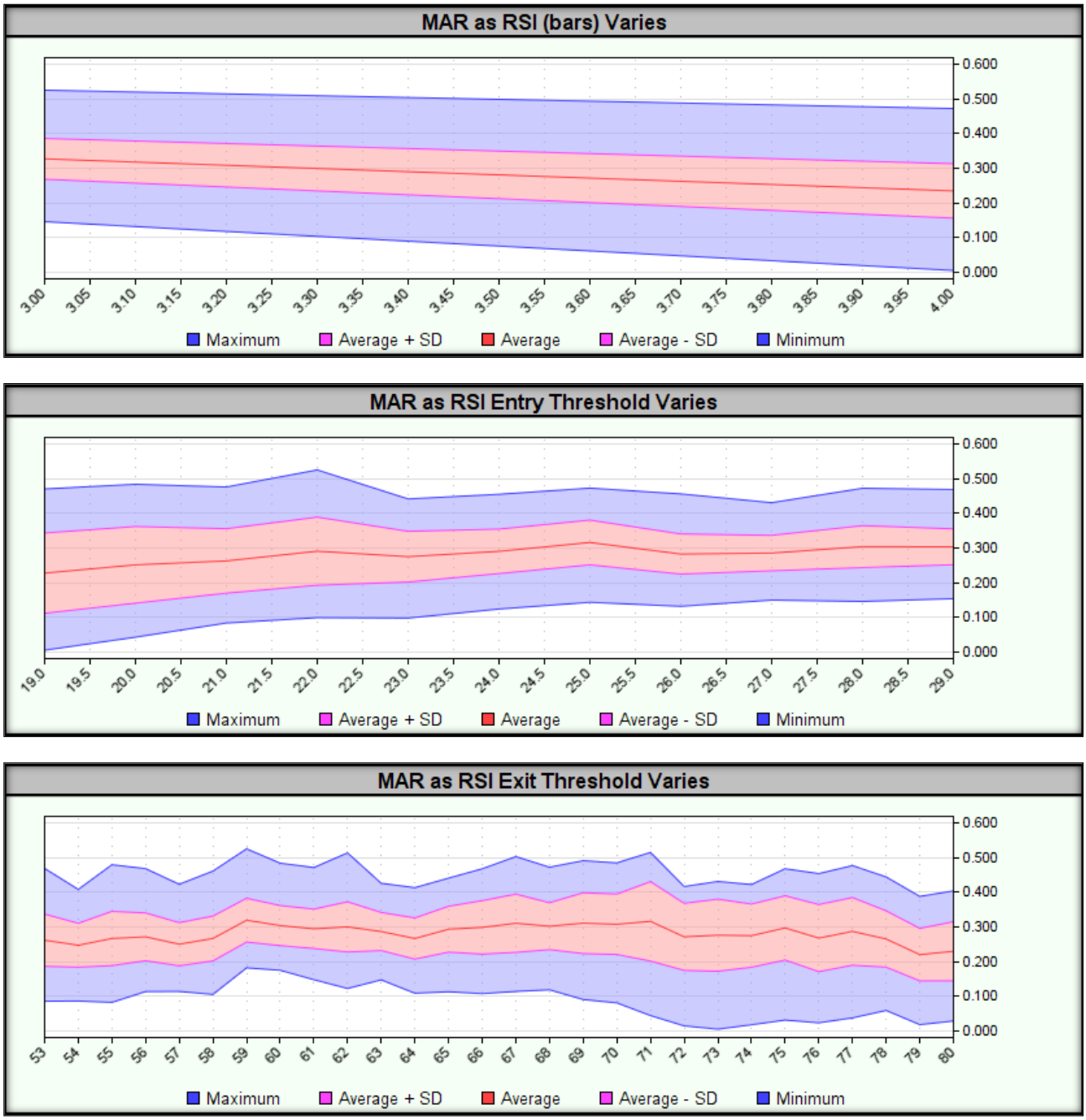

Multi-Parameter Results for MAR
0.45
0.40
0.35
0.30
0.25
0.20
0.15
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
RSI Exit Threshold
3.00
3.05
3.10
3.15
3.20
3.25
3.30
3.35
3.40
3.45
3.50
3.55
3.60
3.65
3.70
3.75
3.80
3.85
3.90
3.95
4.00
RSI (bars)


Multi-Parameter Results for MAR
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
RSI (bars)
80
75
70
65
60
55
50
RSI Exit Threshold


Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
80
78
76
74
72
70
68
66
64
62
60
58
56
54
52
RSI Exit Threshold
19.0
19.5
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
RSI Entry Threshold


Multi-Parameter Results for MAR
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.20
0.18
0.16
19
20
21
22
23
24
25
26
27
28
29
RSI Entry Threshold
80
75
70
65
60
55
50
RSI Exit Threshold


MAR as Moving Average (bars) Varies
0.600
0.500
0.400
0.300
0.200
0.100
0.000
200
205
210
215
220
225
230
235
240
245
250
255
260
265
270
275
280
285
290
295
300
Maximum
Average + SD
Average
Average - SD
Minimum



After passing **the stability test in a wide range of optimized parameters,** we can proceed to **stability testing using Monte Carlo simulation.** The conditions for passing this test are similar to those required in the above step.

2. Monte Carlo simulation

Monte Carlo simulation involves running multiple simulations to examine how a strategy might perform in different market scenarios. The key objective of this method is to assess the potential **drawdown** of an optimized strategy. **Monte Carlo simulation** better reflects the possible swings of the equity curve and the depth of the potential **drawdown,** allowing for a more realistic risk assessment. It is also an ideal opportunity

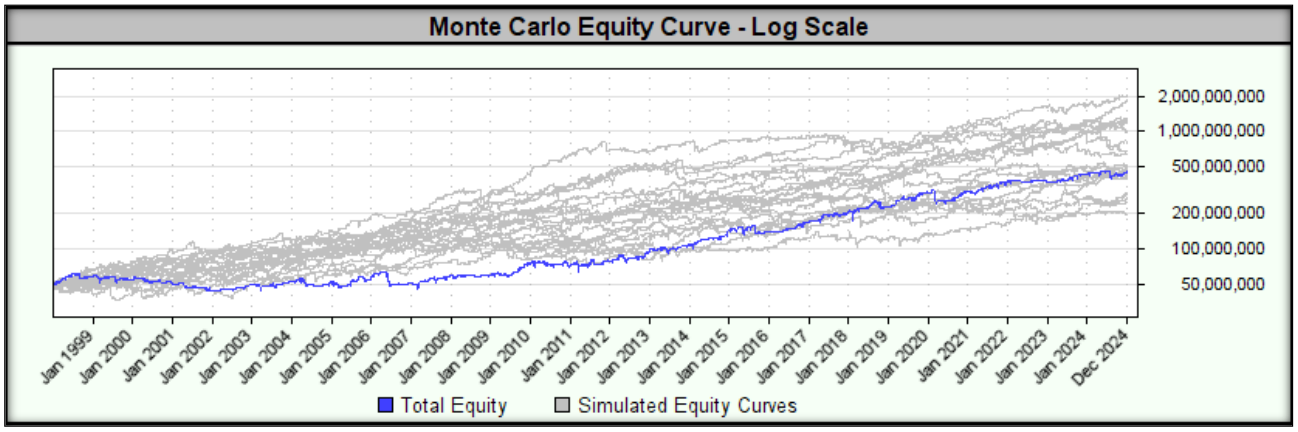
to compare **the drawdown** obtained in tests on optimized parameter ranges with the results of **the Monte Carlo simulation,** using **a 99% confidence interval.**

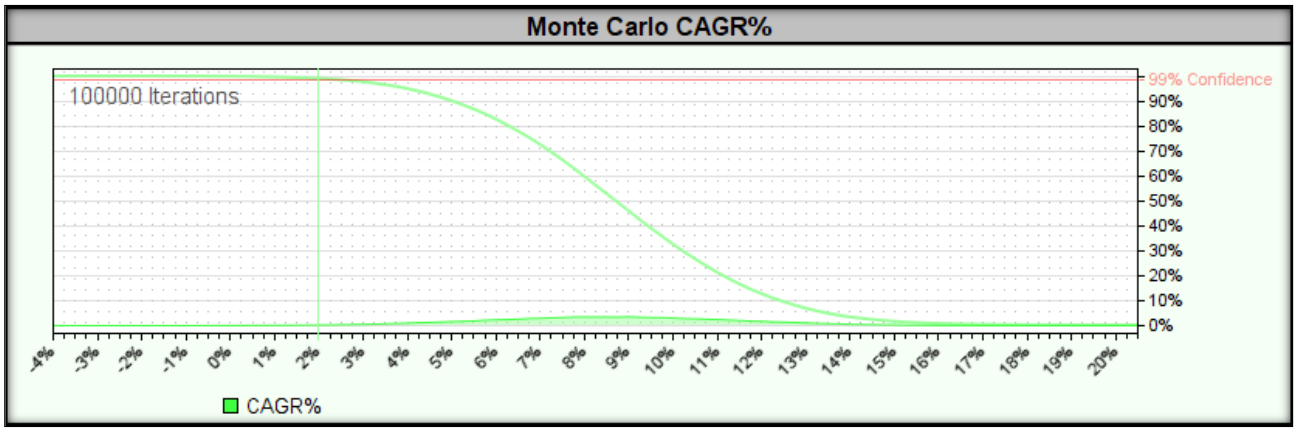
A strategy considered to be **stable (robust)** should achieve **a drawdown in a Monte Carlo simulation** that does not exceed **250% of the drawdown** size **from total tests in-sample and out-of-sample** (for parameters optimized on IS data). Furthermore, the **MAR indicator** should remain positive within the chosen confidence interval.

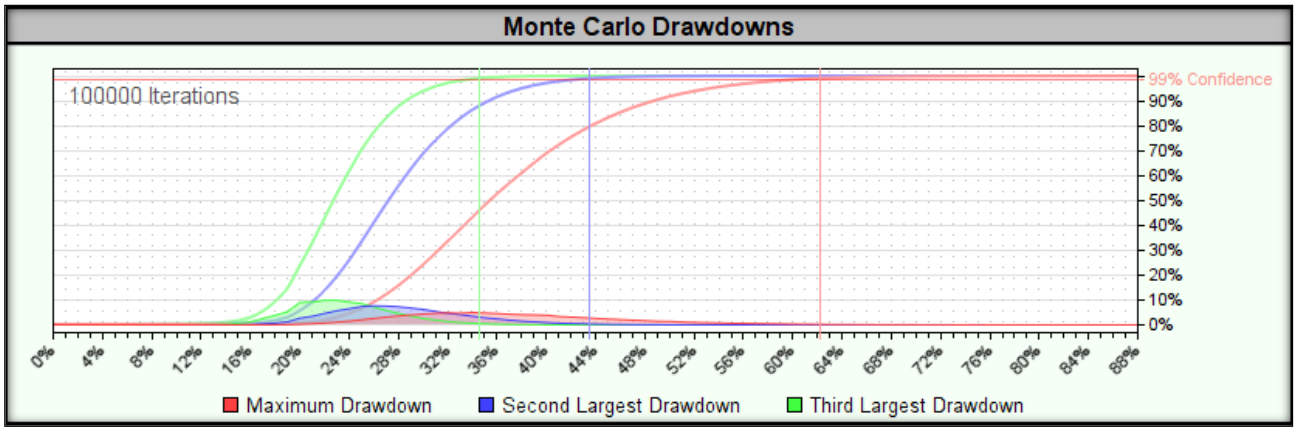
For data covering the period from **01.01.1998 to 31.12.2024** was carried out **Monte Carlo simulation** on **optimal strategy parameters.** The Monte Carlo simulation was performed **100,000 times,** testing **the variant with replacement (more conservative),** and **the confidence interval was set to 99%.**

The simulation with sample replacement are presented below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.







- **CAGR%** – In 99% of simulations achieved **a rate of return equal to or higher than 2%.**
- **Drawdown** – in 99% of simulations, **drawdown equal to or lower than 62% was achieved.** For parameters optimized on in-sample data, drawdown was 29.2%.

The strategy stability criteria were met, as **the drawdown** in **the Monte Carlo simulation** did not exceed **250% of the drawdown** value from tests on **optimized parameters.** In addition, the **MAR indicator** remained positive in **99%** of tests, which was also a condition for the strategy stability.

Now that we know the strategy is **stable** across **wide data ranges** and **a changing environment,** it's time to test its **stability** over **different time periods.**

3. Stability over a moving time window

Rolling window stability testing involves **estimating one- and three-year returns in time windows that move by one year** (for both in-sample and out-of-sample data). This process involves applying **strategy parameters optimized on the in-sample data,** setting a one- or three-year trading window, and moving it by one year.

We then analyze what portion of these one- and three-year periods showed positive returns. **A strategy considered stable (robust) should achieve profitable results in at least 70% of the one- and three-year periods.**

For data covering the period from **01.01.1998 to 31.12.2024** was carried out **testing optimized parameters** on **a moving data window.**

Two variants of test windows were tested:

- **Annual testing window (365 days),** tested **every 365 days** – this means that **we measure the annual rate of return every year.**
- **Three-year testing window (1095 days),** tested **every 365 days** – this means **we measure a three-year rate of return every year.**

A one-year (365/365) testing window are shown below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

	Test Start Date	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades	R3	RAR [%]	%PF	Expectancy
1	19980101	$58,839,845.90	17.69%	1.83	1.37	2.00	9.6%	5.1	40	37.75	13.51	2.40	0.00
2	19990101	$47,900,347.80	-4.21%	-0.28	-0.19	NA	15.2%	11.0	43	-17.66	-4.78	0.82	0.00
3	20000101	$45,743,059.07	-8.61%	-0.62	-0.95	NA	13.9%	11.4	36	-17.15	-7.94	0.58	0.00
4	20010101	$44,529,168.27	-10.95%	-0.77	-1.50	-2.00	14.2%	8.8	23	-22.80	-11.43	0.31	0.00
5	20020101	$54,904,993.20	9.82%	4.04	1.96	2.00	2.4%	2.6	17	146.23	10.33	7.88	0.00
6	20030101	$53,310,301.96	6.63%	0.56	0.87	2.00	11.8%	4.4	29	18.58	6.20	1.57	0.00
7	20040101	$50,317,509.29	0.64%	0.04	0.12	NA	14.8%	9.0	44	-14.16	-10.02	1.09	0.00
8	20050101	$53,040,580.95	6.15%	0.56	0.54	NA	11.0%	6.0	66	20.23	16.03	1.27	0.00
9	20060101	$44,862,160.50	-10.31%	-0.41	-0.40	-2.01	25.1%	8.7	47	-24.38	-25.28	0.75	0.00
10	20070101	$58,476,734.39	16.97%	1.62	1.85	2.00	10.5%	3.0	43	37.44	16.95	2.32	0.00
11	20080101	$50,696,529.42	1.39%	0.35	0.23	NA	3.9%	6.9	26	11.38	3.45	1.17	0.00
12	20090101	$62,459,748.91	24.94%	3.58	2.05	2.00	7.0%	4.8	53	100.60	26.02	3.66	0.00
13	20100101	$47,645,104.28	-4.73%	-0.40	-0.37	NA	11.9%	7.7	64	-6.13	-4.07	0.86	0.00
14	20110101	$52,706,808.14	5.48%	0.29	0.40	NA	19.2%	5.2	47	9.99	7.22	1.32	0.00
15	20120101	$63,736,011.86	27.58%	1.89	1.64	NA	14.6%	6.8	66	33.84	12.46	2.29	0.00
16	20130101	$55,060,478.11	10.13%	0.89	1.20	2.00	11.4%	4.8	40	18.52	7.61	2.36	0.00
17	20140101	$66,818,168.54	33.66%	3.44	2.70	2.00	9.8%	2.6	48	106.66	24.39	4.22	0.00
18	20150101	$48,634,634.73	-2.73%	-0.18	-0.09	-2.00	15.5%	4.9	61	-10.82	-10.15	0.95	0.00
19	20160101	$59,361,095.88	18.79%	3.56	1.48	NA	5.3%	4.0	47	99.74	24.55	2.48	0.00
20	20170101	$60,094,536.32	20.26%	2.84	2.00	2.01	7.1%	3.4	49	69.73	19.36	2.81	0.00
21	20180101	$56,898,828.85	13.81%	0.85	0.85	2.00	16.3%	3.9	50	38.56	18.30	1.74	0.00
22	20190101	$65,747,127.09	31.52%	3.86	2.04	2.00	8.2%	4.2	56	127.62	33.47	3.71	0.00
23	20200101	$50,786,090.49	1.57%	0.07	0.18	NA	24.1%	10.8	54	4.15	3.74	1.15	0.00
24	20210101	$61,502,978.11	23.09%	2.91	1.49	NA	7.9%	2.5	43	125.07	28.88	3.38	0.00
25	20220101	$49,245,809.73	-1.53%	-0.31	-0.29	NA	5.0%	8.5	17	4.71	1.72	0.85	0.00
26	20230101	$57,471,985.86	15.00%	2.88	2.19	2.01	5.2%	2.0	33	172.94	20.49	4.11	0.00
27	20240101	$51,770,126.48	3.54%	0.23	0.36	NA	15.6%	6.8	54	-4.86	-2.65	1.21	0.00

A three-year testing window (1095/365) are shown below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

	Test Start Date	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades	R3	RAR [%]	%PF	Expectancy
1	19980101	$50,499,933.58	0.33%	0.02	0.09	0.03	18.4%	29.0	117	-0.89	-2.10	1.05	0.00
2	19990101	$38,837,772.79	-8.08%	-0.29	-0.69	-2.74	27.5%	35.1	101	-2.81	-7.91	0.59	0.00
3	20000101	$44,520,145.68	-3.80%	-0.15	-0.47	-0.41	25.3%	35.4	75	-2.67	-7.07	0.72	0.00
4	20010101	$52,134,506.19	1.40%	0.10	0.23	0.18	14.2%	27.0	69	0.78	1.75	1.17	0.00
5	20020101	$58,907,831.32	5.62%	0.38	0.63	1.48	14.8%	9.0	90	1.80	4.57	1.55	0.00
6	20030101	$56,892,959.60	4.41%	0.27	0.43	1.64	16.3%	17.1	137	0.71	2.84	1.26	0.00
7	20040101	$48,447,541.37	-1.05%	-0.04	0.02	-0.17	25.1%	17.1	154	0.49	2.72	1.02	0.00
8	20050101	$56,705,384.73	4.30%	0.15	0.35	0.44	28.7%	20.7	154	0.31	1.57	1.25	0.00
9	20060101	$52,660,074.51	1.75%	0.06	0.20	0.15	28.7%	32.7	114	0.88	2.88	1.17	0.00
10	20070101	$73,652,697.01	13.79%	1.31	1.43	1.26	10.5%	6.9	121	5.50	9.52	2.34	0.00
11	20080101	$62,263,152.58	7.59%	0.64	0.78	0.59	11.9%	7.7	143	5.41	12.38	1.50	0.00
12	20090101	$64,383,795.90	8.82%	0.43	0.70	0.76	20.4%	13.9	164	2.50	7.92	1.47	0.00
13	20100101	$64,351,712.12	8.78%	0.43	0.63	0.66	20.4%	13.9	177	1.52	5.89	1.40	0.00
14	20110101	$74,699,217.37	14.36%	0.75	1.01	1.53	19.2%	6.8	153	5.24	15.62	1.90	0.00
15	20120101	$92,637,916.32	22.86%	1.56	1.76	2.67	14.6%	6.8	152	13.22	19.07	2.73	0.00
16	20130101	$70,052,723.77	11.91%	0.77	0.94	0.91	15.5%	4.9	147	9.59	18.57	1.77	0.00
17	20140101	$78,182,873.39	16.10%	1.04	1.18	1.07	15.5%	13.6	156	4.92	11.31	1.93	0.00
18	20150101	$71,482,412.63	12.69%	0.82	0.99	1.12	15.5%	13.6	157	5.01	13.24	1.73	0.00
19	20160101	$80,794,036.02	17.36%	0.95	1.32	3.80	18.2%	4.0	146	14.40	22.44	2.15	0.00
20	20170101	$88,110,590.54	20.82%	1.14	1.48	1.79	18.2%	6.6	155	12.11	19.38	2.41	0.00
21	20180101	$76,235,595.11	15.11%	0.63	1.01	1.22	24.2%	10.8	160	3.32	11.12	1.80	0.00
22	20190101	$82,034,734.84	17.96%	0.74	1.20	1.43	24.2%	14.9	153	4.72	12.49	2.09	0.00
23	20200101	$61,363,262.01	7.08%	0.29	0.60	0.66	24.1%	14.9	114	4.93	16.34	1.50	0.00
24	20210101	$69,724,600.91	11.73%	1.48	1.15	1.14	7.9%	8.5	93	9.13	9.93	2.51	0.00
25	20220101	$58,738,481.39	5.53%	0.35	0.70	0.79	15.6%	8.5	104	3.99	7.68	1.51	0.00

In both cases, **success** is completing at least **70% of the periods** (both **365-day** and **1095-day) with positive returns.**

- **For the one-year test window (365/365): 20 out of 27 periods** ended with a positive rate of return **(74%)**.
- **For the three-year test window (1095/365): 22 out of 25 periods** ended with a positive rate of return **(88%)**.

Thus, **the test of the strategy's stability on a moving data window was passed.**

4. **Stability long/short**

In the case of many instruments, markets have **a natural tendency** to move in an upward direction (so-called **Long Bias)**, which makes investing in bullish scenarios often easier than betting on bearish scenarios. **Optimizing a strategy** for a bullish scenario, which is usually implied by the data used for optimization, can

lead to **problems** when markets enter **long-term bearish trends.** In such conditions, the strategy can generate **significant losses.**

To check if **the strategy** shows a tendency to **Long Bias** or (less often) **Short Bias, the distribution of historical buy and sell transactions** should be verified. Ideally, this distribution should be around **50%/50%.** However, if one side is significantly favored (e.g. **70%/30%)**, the strategy may be **unstable** in a real market environment.

A strategy considered stable (robust) should show a maximum of **60% tendency (bias)** in one direction.

In the case of the RSI PowerZone v.3 strategy testing **long/short stability** does not make sense because **the strategy** involves opening **only long positions.**

5. **Stability in the portfolio of financial instruments**

In this step, we want to examine **how the strategy's performance is distributed across different instruments in the portfolio.** Our goal is **to avoid a situation where the strategy's positive performance comes only from a small group of exceptionally well- performing instruments.**

To check this, for **the in-sample and out-of-sample data combined,** we analyze **what percentage of instruments achieved a profit factor value above 1** (which means a positive contribution to the strategy's result).

We expect that:

- **For the portfolio with the highest MAR** (obtained on IS data), the percentage of instruments with **profit factor > 1 will be at least 80%.**
- **For the portfolio with the lowest MAR** (obtained on IS data), the percentage of instruments with **profit factor > 1 will be at least 70%.**

If the above conditions are met, **we can consider that the strategy is stable on a wide basket of financial instruments.**

The profit factor for the instruments included in the portfolio using the highest MAR is presented below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Instrument Performance Summary

Symbol	Wins	%	Losses	%	Trades	Win Months	%	Loss Months	%	Avg. Win %	Avg. Loss %	Avg. Trade %	% Profit Factor
DX	55	51.9%	51	48.1%	106	279	86.1%	45	13.9%	0.84%	0.82%	0.04%	1.11
EBL	68	54.8%	56	45.2%	124	279	86.1%	45	13.9%	0.89%	0.92%	0.07%	1.17
ES	105	74.5%	36	25.5%	141	287	88.6%	37	11.4%	0.97%	1.10%	0.44%	2.57
FDX	87	70.7%	36	29.3%	123	285	88.0%	39	12.0%	0.94%	1.05%	0.36%	2.16
FLG	76	62.3%	46	37.7%	122	283	87.3%	41	12.7%	0.91%	0.94%	0.21%	1.59
GC	61	58.7%	43	41.3%	104	286	88.3%	38	11.7%	0.81%	0.69%	0.19%	1.67
HSI	60	57.7%	44	42.3%	104	287	88.6%	37	11.4%	0.94%	0.97%	0.13%	1.31
NIY	57	60.0%	38	40.0%	95	290	89.5%	34	10.5%	1.01%	1.39%	0.05%	1.09
NQ	106	72.1%	41	27.9%	147	283	87.3%	41	12.7%	0.91%	1.18%	0.33%	2.00
TY	73	60.8%	47	39.2%	120	285	88.0%	39	12.0%	0.77%	1.02%	0.07%	1.17

The profit factor for the instruments included in the portfolio **using the lowest MAR** is presented below.

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Instrument Performance Summary													
Symbol	Wins	%	Losses	%	Trades	Win Months	%	Loss Months	%	Avg. Win %	Avg. Loss %	Avg. Trade %	% Profit Factor
DX	241	64.1%	135	35.9%	376	259	79.9%	65	20.1%	0.37%	0.63%	0.01%	1.05
EBL	303	65.2%	162	34.8%	465	250	77.2%	74	22.8%	0.39%	0.62%	0.04%	1.17
ES	356	70.2%	151	29.8%	507	252	77.8%	72	22.2%	0.39%	0.75%	0.05%	1.25
FDX	297	66.7%	148	33.3%	445	252	77.8%	72	22.2%	0.43%	0.72%	0.05%	1.20
FLG	270	62.6%	161	37.4%	431	251	77.5%	73	22.5%	0.39%	0.58%	0.03%	1.13
GC	237	60.9%	152	39.1%	389	247	76.2%	77	23.8%	0.34%	0.57%	-0.02%	0.92
HSI	270	66.7%	135	33.3%	405	258	79.6%	66	20.4%	0.45%	0.70%	0.07%	1.29
NIY	214	65.2%	114	34.8%	328	267	82.4%	57	17.6%	0.41%	0.83%	-0.02%	0.94
NQ	374	70.8%	154	29.2%	528	256	79.0%	68	21.0%	0.41%	0.64%	0.10%	1.55
TY	294	66.1%	151	33.9%	445	256	79.0%	68	21.0%	0.38%	0.55%	0.07%	1.36

For our tested strategy:

- **The portfolio with the highest MAR** (obtained on IS data) has a percentage of instruments with **profit factor > 1 at the level of 100%.**
- **The portfolio with the lowest MAR** (obtained on IS data) has a percentage of instruments with **profit factor > 1 at the level of 80%.**

Thus, **the test of the stability of the strategy on the portfolio of financial instruments was passed.**

6. Money Management (Position Sizing)

Once **stability testing is complete,** we now know **what range of results we can expect from our strategy,** and more importantly – **what amount of capital loss (drawdown).**

Previous tests show that:

- **Drawdown in-sample** for optimized parameters was **24.2%.**
- **In-sample and out-of-sample drawdown** for the optimized parameters was **29.2%.**
- **The highest in-sample drawdown** for the tested parameter range was **55.7%.**
- **The largest out-of-sample drawdown** for the tested parameter range was **40.6%.**
- **Drawdown** was equal to or lower than **62.0% in 99% of the Monte Carlo simulations.**

Our investment strategy was tested assuming that **the risk of a single position (two units in total) is 2.0% of the total capital, with a hypothetical stop loss order placed 2 x ATR (40 days) away from the position opening point.**

With the above information in mind, you should consider **whether the risk of a single position is acceptable, taking into account the possible drawdown.**

At this stage, **this position size is acceptable to me personally, but I will make the final decision after conducting Walk Forward Analysis tests.**

To summarize, at this point **the strategy has been optimized to the following parameters:**

- **Length of the moving average (SMA):** 250;
- **RSI lengths:** 4;
- **RSI Entry Threshold:** 19;
- **RSI Exit Threshold (take profit):** 73;

- **Stop loss:** the closing price of the instrument falls below the moving average;
- **Method of opening a position:** at the opening price of the next day;
- **Position size:** corresponding to the risk of 2.0% of the total capital, with a hypothetical stop loss order located 2 x ATR (40 days) away from the position opening position;
- **Size of 1 unit:** 50%;
- **Size 2 units:** 50%;
- **Position direction:** long positions (buy) only.

7. **Strategy Risk Management**

In addition to defining **the maximum size of a single position,** we can implement additional mechanisms that **will improve risk control** in the investment strategy. Key elements include:

- **Maximum number of open positions in highly correlated instruments,**
- **Maximum number of open positions in moderately correlated instruments,**
- **Maximum number of open positions in one direction,**
- **Maximum risk value of all positions,**
- **Drawdown – position reduction mechanism.**

The optimal values for these parameters can be determined by **maximizing the MAR objective function.** However, based on experience and **awareness of the risk of** excessive **portfolio concentration in one direction (long/short)** or **too large exposure to correlated instruments,** I adopt **certain arbitrary concentration limits.**

These are not the "best" optimal values for all market conditions – as with position size, sometimes **it is worth reducing it and sometimes it is worth increasing it.** However, the key goal is **to avoid a drawdown** that could force you **to end your strategy** for **financial or emotional reasons.**

Too much concentration in correlated instruments or in one market direction can undermine diversification, which is one of the strategy's key sources of advantage.

Therefore, **I assume the following concentration limits without optimization:**

- **Maximum number of open positions in highly correlated instruments: 6 positions (units),**
- **Maximum number of open positions in moderately correlated instruments: 12 positions (units),**
- **Maximum number of open positions in one direction: 24 positions (units).**

After this step, we have already **optimized all the elements of the investment strategy.** We can finally **analyze the results generated by the strategy in more detail.**

We haven't done this before because our goal **was not to optimize the parameters themselves and look for the "best" set,** but **to build a stable strategy.**

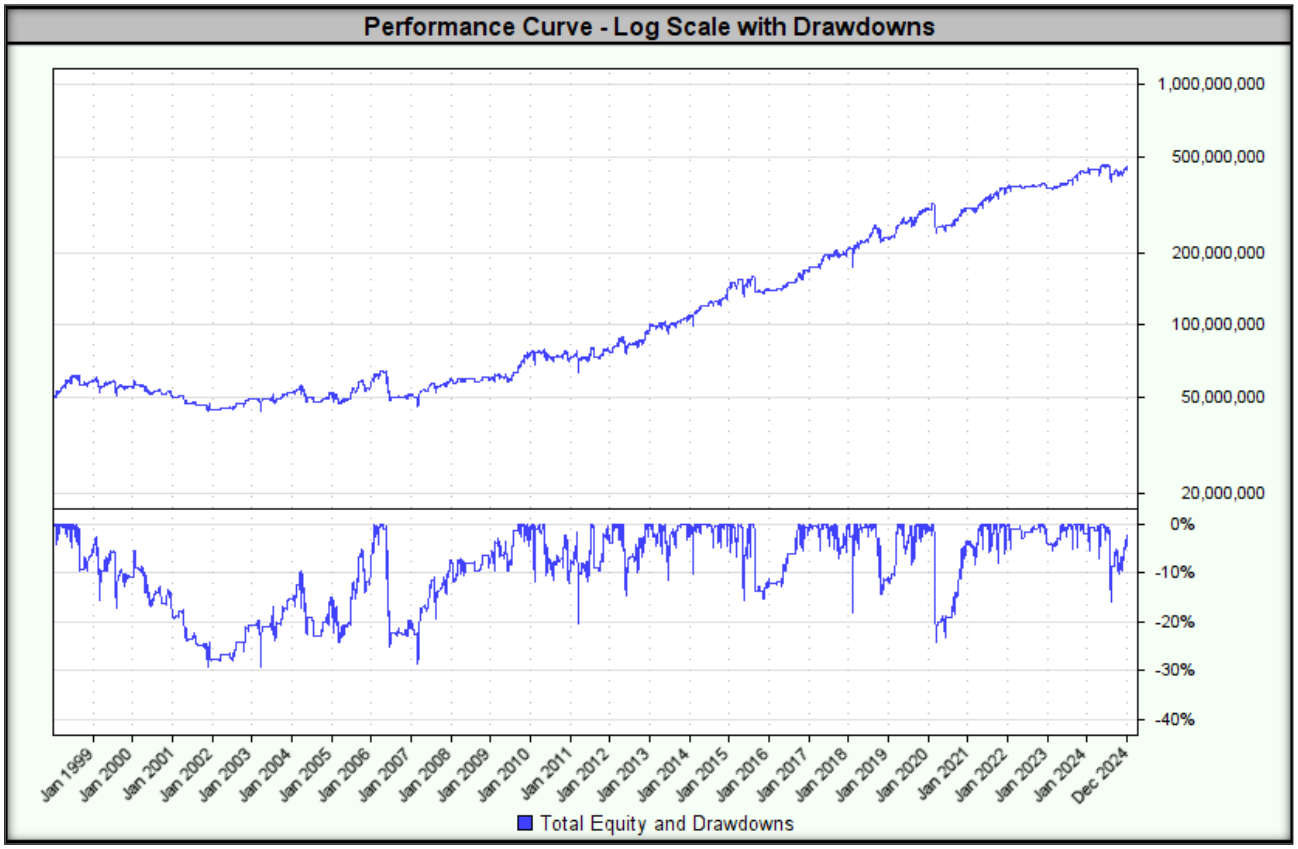
Importantly, **we will not use the parameters optimized in back -tests in the end,** because **they serve only as a reference point. The parameters used in real transactions will be determined during the Walk Forward Analysis.**

Before we move on to this step, **let us summarize the results on the in-sample data and on the combined in-sample and out-of-sample data.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Indicators/Measures	In-sample	In-sample & Out-of-sample
CAGR%	12.8%	8.4%
MAR Ratio	0.53	0.29
RAR%	14.2%	9.6%
R- Cubed	1.15	0.17
Robust Sharpe Ratio	1.14	0.76
Max Drawdown	24.2%	29.2%
Wins	64.4%	63.1%
Losses	35.6%	36.9%
Average Win%	0.92%	0.90%
Average Loss %	0.91%	1.00%
Win/ Loss Ratio	1.02	0.91
Average Trade Duration (days)	16	16
Percent Profit Factor	1.84	1.55
SQN	-	-
Number of transactions	848	1186

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



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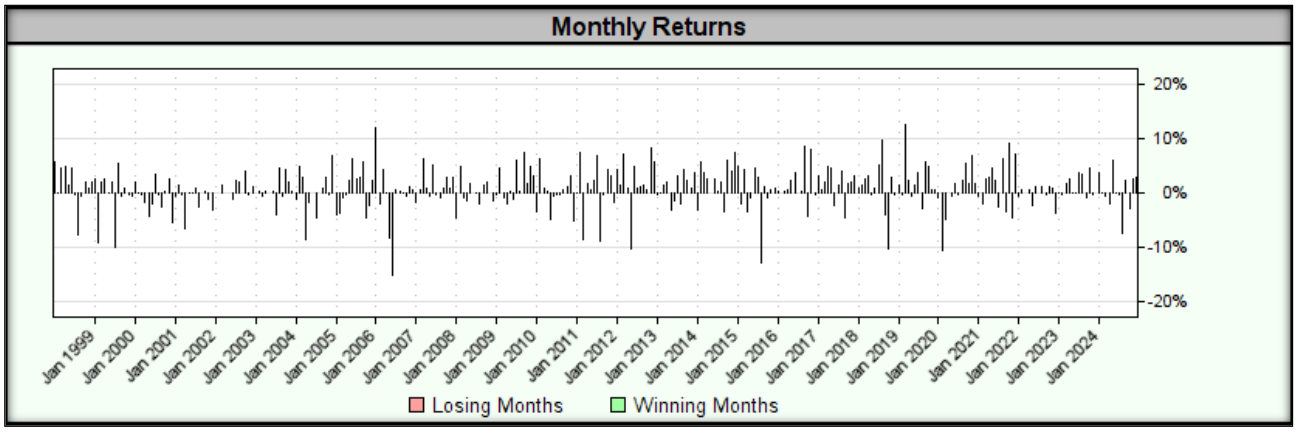
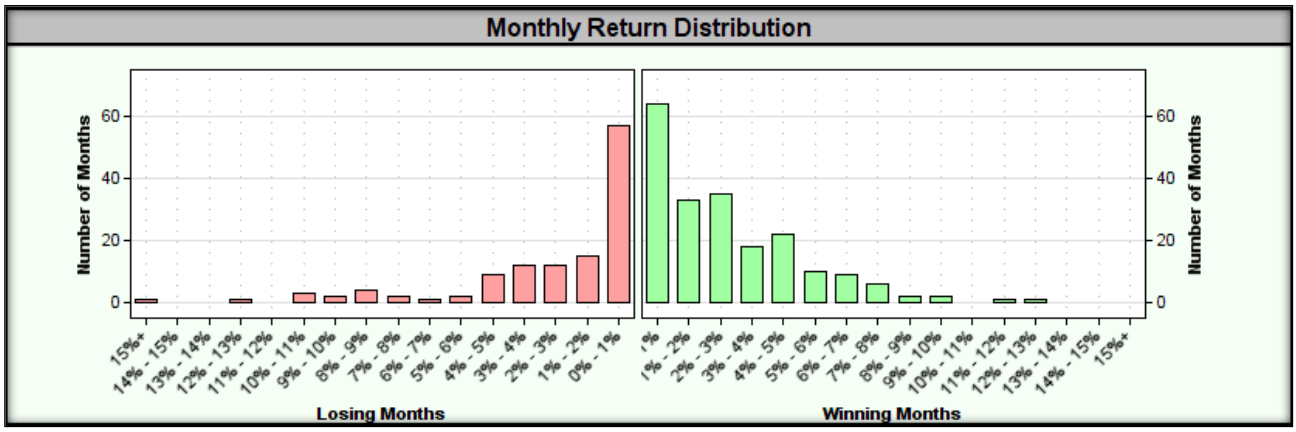


Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



To summarize, at this point **the strategy has been optimized to the following parameters:**

- **Length of the moving average (SMA):** 250;
- **RSI lengths:** 4;
- **RSI Entry Threshold:** 19;
- **RSI Exit Threshold (take profit):** 73;
- **Stop loss:** the closing price of the instrument falls below the moving average;
- **Method of opening a position:** at the opening price of the next day;
- **Position size:** corresponding to the risk of 2.0% of the total capital, with a hypothetical stop loss order located 2 x ATR (40 days) away from the position opening position;
- **Size of 1 unit:** 50%;
- **Size 2 units:** 50%;
- **Maximum number of open positions in different categories:**
  - **Highly correlated instruments:** 6 items (units);
  - **Moderately correlated instruments:** 12 items (units);
  - **Maximum number of positions in one direction:** 24 positions (units);
- **Position direction:** long positions (buy) only.

Step 5: Walk Forward Analysis

Walk Forward Analysis (WFA) is a key tool for assessing **a strategy's ability to perform under real market conditions.** It provides **reliable measures of profit and risk** after the optimization process and allows for answering several key questions:

1. **What rate of return can you expect from the strategy?**
    - The optimization result often overestimates the expected rate of return, which can lead to unrealistic forecasts.
    - WFA provides a more **reliable and realistic measure of return** by minimizing the impact of overfitting to historical data.
2. **What set of parameters should be used in the next period?**
    - Thanks to **WFA,** it is possible **to dynamically adjust the strategy parameters** to **the latest market changes,** increasing its adaptability.

WFA tests the strategy over multiple time periods, which helps **minimize the risk of overfitting** (overfitting the strategy to historical data). The WFA process consists of **two repeated steps:**

1. **Optimization (In-sample):**
    - The strategy is optimized over a specific **training period** (**in-sample)**.
    - In this step, parameters are adjusted to obtain **the best results.**
2. **Testing (Out-of-sample):**
    - The strategy, using **the parameters optimized in Step 1,** is tested on **a test period** (**out-of-sample)**.
    - This stage verifies the effectiveness of the strategy in new market conditions that **were not used** during optimization.

Walk Forward Efficiency (WFE) is a key measure that assesses whether a strategy has the potential to perform under real market conditions. WFE compares:

- **The rate of return achieved in the in-sample window** (where parameters were optimized)
- **The rate of return in the out-of-sample window** (where the strategy was operating on unknown data)

Similarly, **for the drawdown value,** WFE checks whether the strategy does not lose significant stability outside the optimization period.

A strategy considered **stable (robust) should meet the following conditions:**

- **WFE ≥ 50% for the rate of return** – means that the strategy retains at least half of its effectiveness outside the optimization period.
- **WFE ≤ 150% for drawdown** – means that the drawdown outside the optimization period is not significantly higher than during the optimization period.

The WFA results and the assessment of the strategy effectiveness according to the Walk Forward measure are presented below. **Efficiency.**

Parameters **Walk Forward Optimization (WFO):**

- **Objective function:** MAR;
- **Position size:** corresponding to the risk of 2.0% of the total capital, with a hypothetical stop loss order located 2 x ATR (40 days) away from the position opening position;
- **Range of optimized parameters:**
  - **Moving average lengths (SMA):** 200-300 days (step: 10);
  - **RSI lengths:** 3-4 days (step: 1);
  - **RSI Entry Threshold:** 19-29 (step: 1);
  - **RSI Exit Threshold (take profit):** 53-80 (step: 1);
- **Method of opening a position:** at the opening price of the next day;
- **Stop loss:** the closing price of the instrument falls below the moving average;
- **Size of 1 unit:** 50%;
- **Size 2 units:** 50%;
- **Maximum number of open positions in different categories:**
  - **Highly correlated instruments:** 6 items (units);
  - **Moderately correlated instruments:** 12 items (units);
  - **Maximum number of positions in one direction:** 24 positions (units);
- **Position direction:** long positions only (buy);
- **Data period:** 01/01/1995 – 31/12/2024.

Below are the test results for different windows.

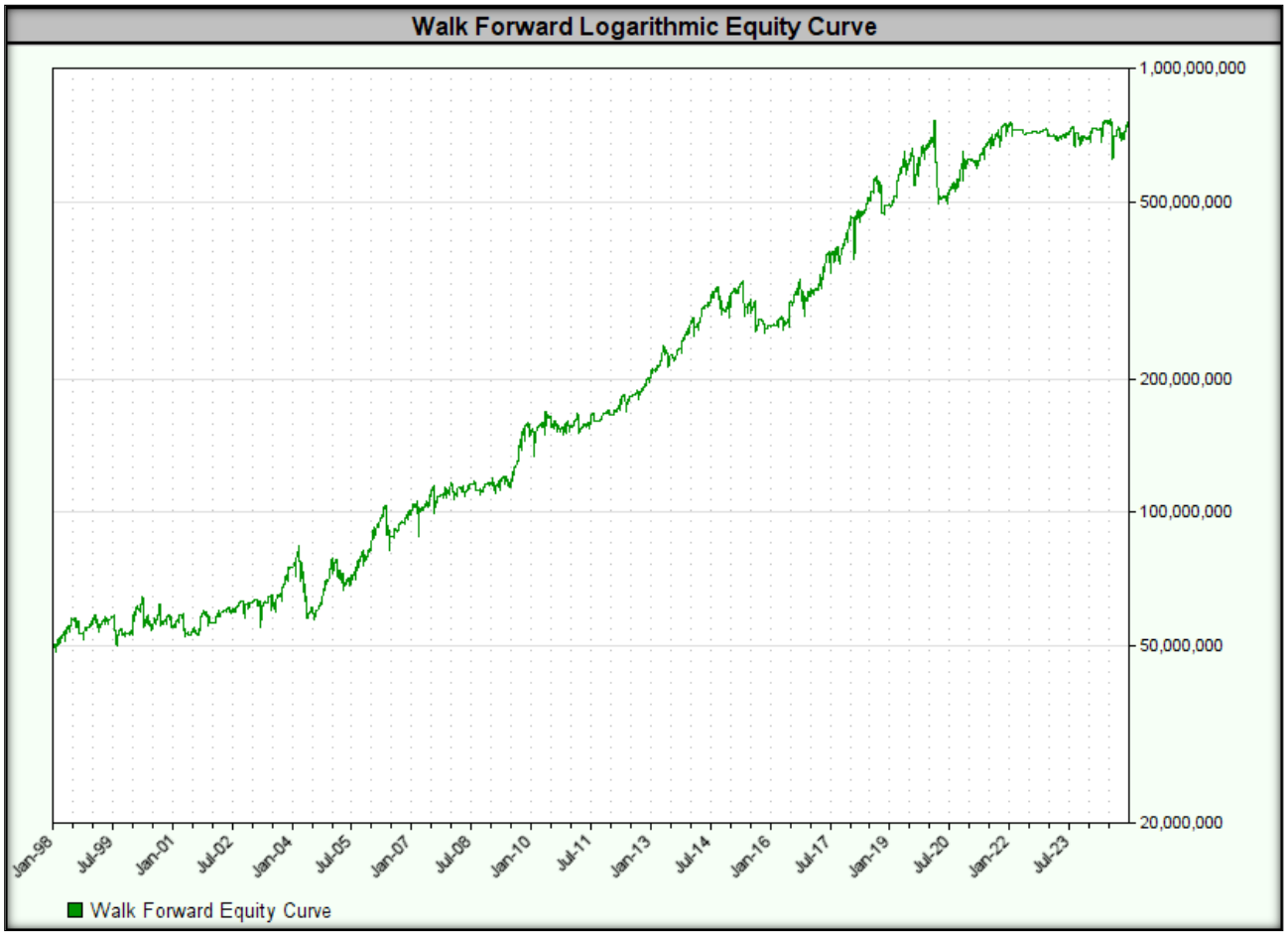
1. **Walk Forward Optimization: 1095 days; Walk Forward Out-of-sample: 365 days**

Below are **the results of Walk Forward Analysis (WFA) for 1095/365 day combinations.**

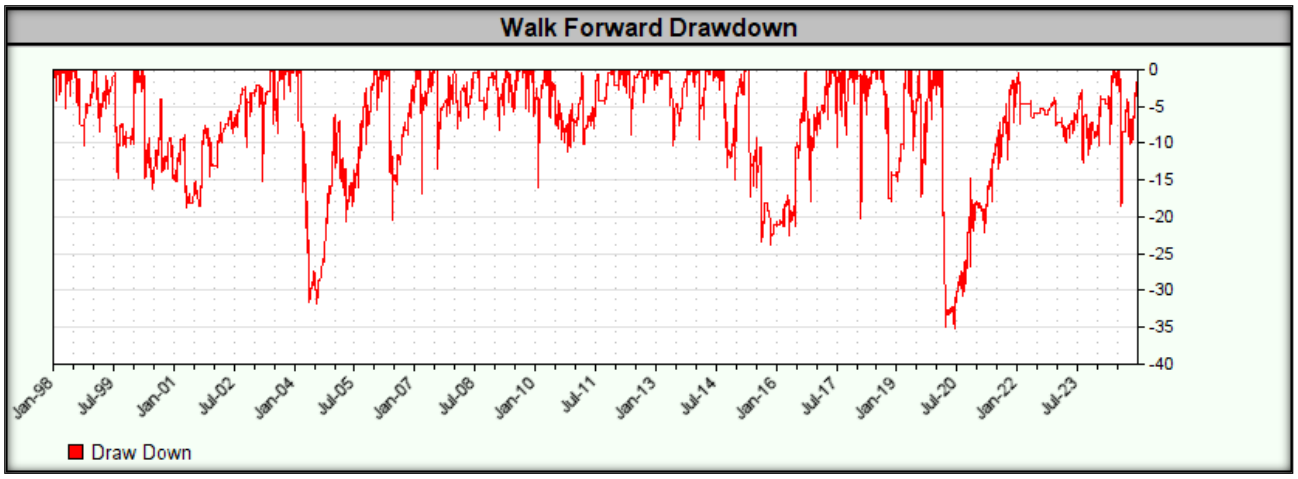
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
762,573,208	10.62%	0.30	0.51	35.13%	51.12	2,446

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	1095	CAGR%		Max DD		MAR	
WFA:	365	Projections	Real	Projections	Real	Projections	Real
19971231	19981230	23.0%	13.8%	7.8%	10.2%	2.95	1.35

19981231	19991230	14.3%	-5.2%	6.3%	14.8%	2.28	- 0.35
19991231	20001229	27.5%	2.2%	16.1%	16.2%	1.71	0.14
20010101	20011228	22.4%	2.3%	17.1%	10.9%	1.31	0.21
20011231	20021227	16.4%	11.5%	17.2%	8.4%	0.95	1.36
20021230	20031229	13.8%	20.2%	12.7%	13.5%	1.09	1.50
20031230	20041228	16.1%	2.2%	14.3%	31.7%	1.13	0.07
20041229	20051228	14.5%	11.3%	14.4%	15.5%	1.00	0.73
20051229	20061228	18.1%	17.3%	13.5%	20.5%	1.35	0.84
20061229	20071228	15.1%	15.6%	14.5%	16.9%	1.05	0.92
20071231	20081226	25.9%	-0.2%	17.8%	7.9%	1.45	- 0.02
20081229	20091225	16.1%	31.1%	12.8%	8.2%	1.25	3.81
20091228	20101227	20.4%	3.4%	11.1%	13.7%	1.84	0.25
20101228	20111227	15.7%	6.4%	6.0%	9.7%	2.60	0.65
20111228	20121226	16.1%	21.2%	6.0%	8.8%	2.67	2.40
20121227	20131226	22.9%	31.1%	10.9%	10.4%	2.10	3.00
20131227	20141226	28.6%	15.9%	10.5%	14.9%	2.72	1.07
20141229	20151225	22.8%	-14.3%	8.8%	23.7%	2.59	- 0.60
20151228	20161223	22.9%	17.4%	18.9%	17.9%	1.21	0.97
20161226	20171225	30.6%	44.1%	23.3%	10.6%	1.31	4.18
20171226	20181225	27.1%	10.8%	17.4%	20.2%	1.56	0.53
20181226	20191225	31.1%	39.9%	19.2%	17.2%	1.62	2.32
20191226	20201224	32.4%	-9.3%	19.2%	35.1%	1.69	- 0.27
20201225	20211224	14.6%	20.1%	24.1%	7.9%	0.60	2.53
20211227	20221223	15.4%	-5.5%	19.9%	7.2%	0.77	- 0.77
20221226	20231222	15.2%	-1.9%	25.6%	10.1%	0.59	- 0.19
20231225	20241223	16.7%	8.5%	7.9%	18.5%	2.11	0.46
Mean		**20.6%**	**11.5%**	**14.6%**	**14.8%**	**0.80**	**0.33**
		WFE:	**55.8%**	**WFE:**	**101.8%**	**WFE:**	**40.7%**

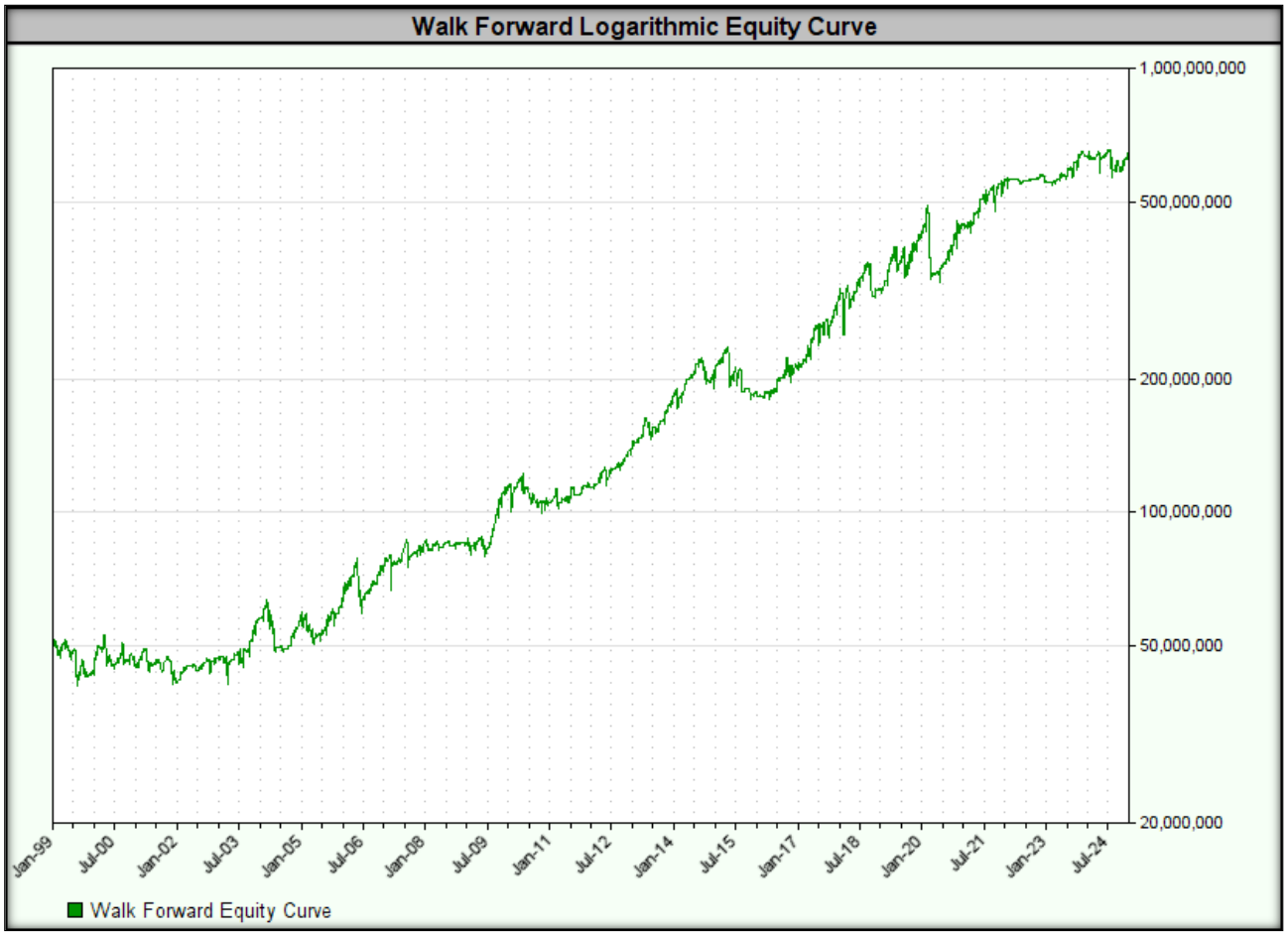
2. **Walk Forward Optimization: 1460 days; Walk Forward Out-of-sample: 365 days**

Below are **the results of Walk Forward Analysis (WFA) for 1460/365 day combinations.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
648,418,785	10.36%	0.31	0.49	33.07%	42.87	2,385

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



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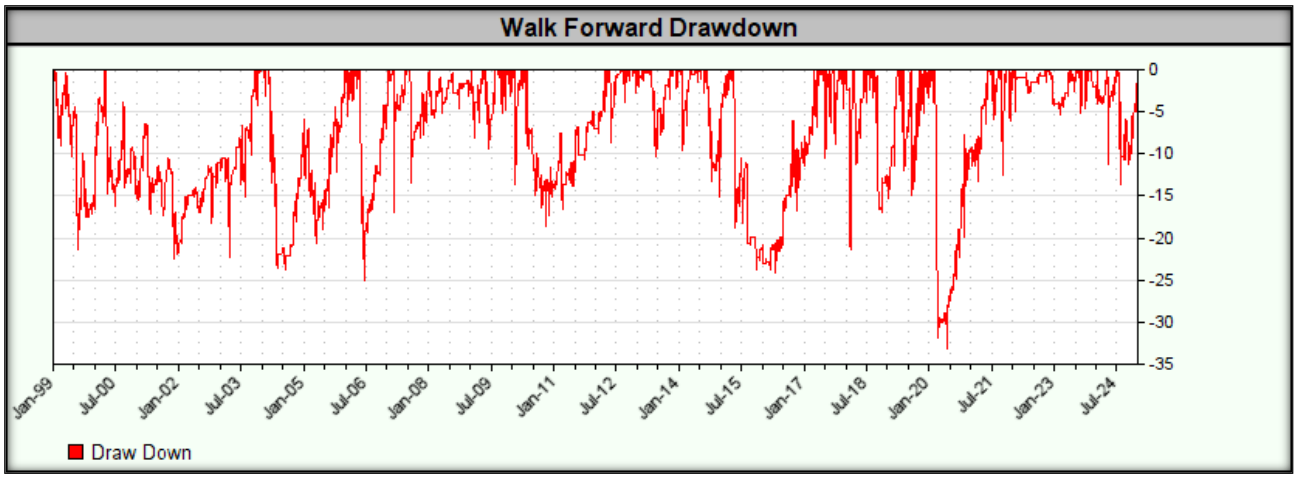


Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	1460	CAGR%		Max DD		MAR	
WFA:	365	Projections	Real	Projections	Real	Projections	Real
19981231	19991230	20.3%	-12.0%	8.8%	21.3%	2.31	- 0.57

19991231	20001229	24.3%	2.3%	16.1%	16.2%	1.51	0.14
20010101	20011228	20.9%	-7.9%	16.6%	17.1%	1.26	- 0.46
20011231	20021227	17.0%	13.4%	16.0%	7.7%	1.06	1.75
20021230	20031229	15.1%	23.0%	16.0%	13.1%	0.94	1.76
20031230	20041228	15.4%	0.9%	13.5%	23.8%	1.14	0.04
20041229	20051228	10.2%	9.8%	14.5%	15.7%	0.71	0.62
20051229	20061228	13.6%	17.8%	14.4%	25.1%	0.94	0.71
20061229	20071228	17.0%	14.7%	15.2%	16.9%	1.12	0.87
20071231	20081226	13.2%	-1.1%	13.7%	5.4%	0.96	- 0.21
20081229	20091225	18.7%	32.8%	17.8%	9.4%	1.05	3.49
20091228	20101227	19.6%	-6.5%	12.8%	18.5%	1.53	- 0.35
20101228	20111227	16.5%	7.8%	8.7%	9.7%	1.90	0.80
20111228	20121226	11.4%	22.2%	7.0%	8.7%	1.63	2.55
20121227	20131226	24.2%	31.1%	11.0%	10.4%	2.21	3.00
20131227	20141226	24.3%	15.2%	10.9%	15.1%	2.23	1.01
20141229	20151225	23.2%	-11.4%	10.8%	23.8%	2.15	- 0.48
20151228	20161223	24.4%	13.4%	19.0%	11.4%	1.29	1.18
20161226	20171225	28.4%	44.3%	23.4%	10.6%	1.22	4.19
20171226	20181225	32.9%	4.5%	21.3%	21.3%	1.54	0.21
20181226	20191225	24.8%	35.6%	21.3%	15.0%	1.16	2.37
20191226	20201224	33.5%	3.3%	19.2%	33.1%	1.74	0.10
20201225	20211224	21.0%	24.3%	27.9%	12.5%	0.75	1.95
20211227	20221223	16.2%	0.9%	24.2%	5.0%	0.67	0.17
20221226	20231222	12.9%	14.7%	24.2%	5.2%	0.54	2.82
20231225	20241223	10.7%	0.1%	25.6%	13.6%	0.42	0.00
Mean		**19.6%**	**11.3%**	**16.5%**	**14.8%**	**0.70**	**0.34**
		WFE:	**57.5%**	**WFE:**	**89.7%**	**WFE:**	**48.4%**

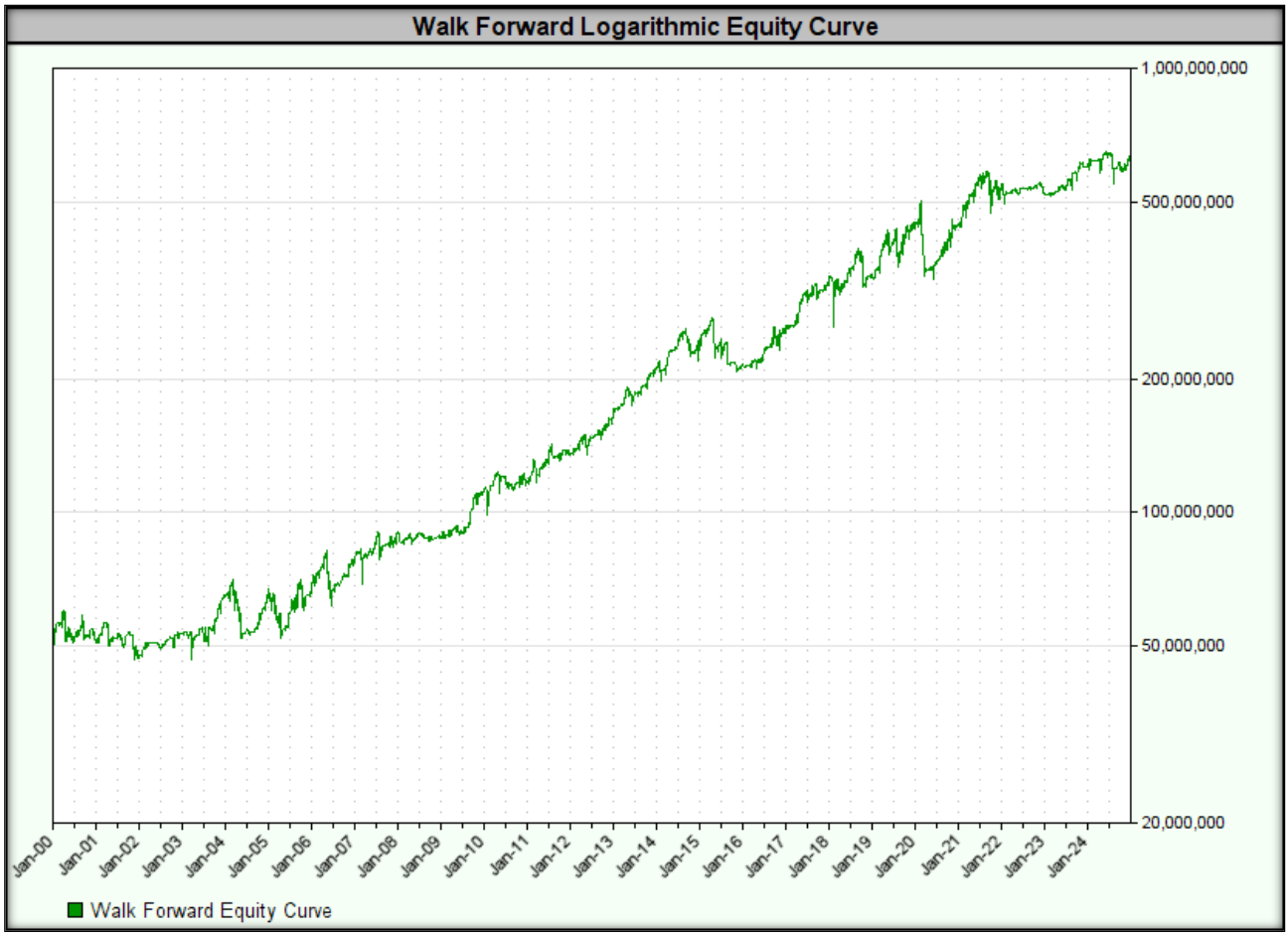
3. Walk Forward Optimization: 1825 days; Walk Forward Out-of-sample: 365 days

Below are **the results of Walk Forward Analysis (WFA) for 1825/365 day combinations.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
621,985,329	10.61%	0.32	0.50	33.07%	43.01	2,161

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



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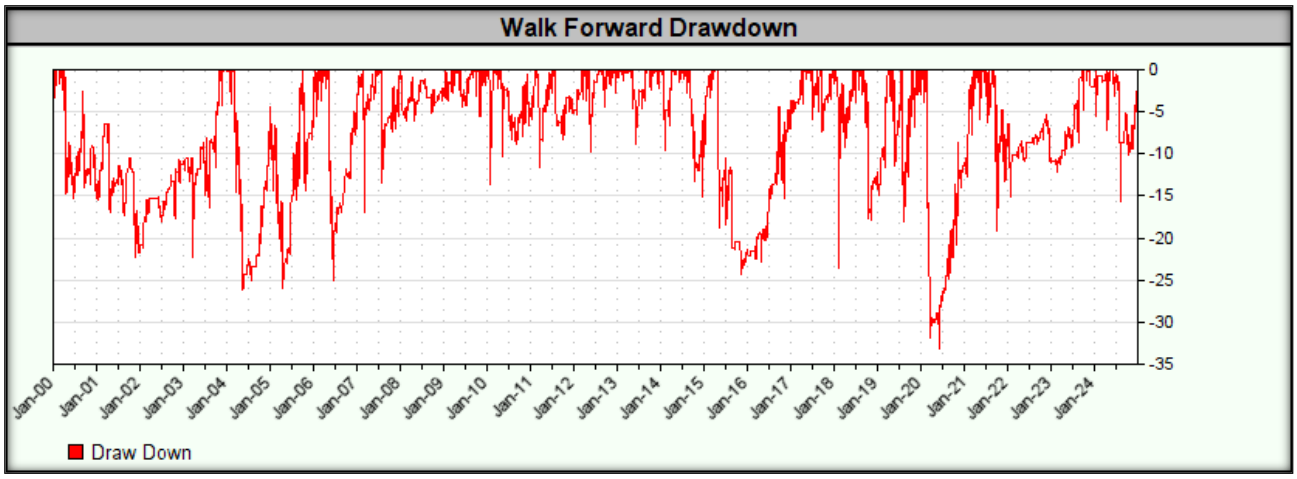


Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	1825	CAGR%		Max DD		MAR	
WFA:	365	Projections	Real	Projections	Real	Projections	Real
19991231	20001229	25.3%	2.5%	16.6%	15.3%	1.53	0.16

20010101	20011228	19.8%	-7.9%	16.6%	17.1%	1.20	- 0.46
20011231	20021227	15.9%	13.3%	16.0%	5.8%	0.99	2.30
20021230	20031229	16.4%	21.6%	16.0%	13.1%	1.03	1.64
20031230	20041228	16.6%	1.5%	16.0%	26.1%	1.04	0.06
20041229	20051228	12.3%	1.6%	22.5%	22.7%	0.55	0.07
20051229	20061228	10.8%	16.4%	15.1%	25.1%	0.71	0.65
20061229	20071228	13.7%	16.1%	15.5%	16.9%	0.88	0.95
20071231	20081226	15.6%	-1.9%	15.7%	6.1%	0.99	- 0.32
20081229	20091225	10.1%	26.4%	13.7%	5.6%	0.74	4.74
20091228	20101227	16.8%	4.9%	13.5%	13.7%	1.25	0.36
20101228	20111227	16.6%	15.3%	14.1%	11.6%	1.18	1.32
20111228	20121226	14.7%	21.4%	9.7%	9.7%	1.51	2.19
20121227	20131226	17.7%	28.8%	10.6%	8.9%	1.67	3.24
20131227	20141226	25.1%	15.2%	11.0%	15.2%	2.29	1.01
20141229	20151225	21.4%	-12.1%	11.0%	24.4%	1.94	- 0.50
20151228	20161223	22.9%	19.2%	19.0%	11.4%	1.20	1.69
20161226	20171225	20.7%	29.1%	17.2%	7.4%	1.20	3.93
20171226	20181225	31.4%	4.0%	23.4%	23.7%	1.34	0.17
20181226	20191225	26.9%	32.1%	21.3%	18.0%	1.26	1.78
20191226	20201224	28.0%	-1.3%	21.7%	33.1%	1.29	- 0.04
20201225	20211224	26.3%	19.9%	32.7%	19.2%	0.80	1.04
20211227	20221223	21.7%	-1.6%	27.9%	9.2%	0.78	- 0.18
20221226	20231222	12.9%	14.8%	24.2%	5.2%	0.53	2.82
20231225	20241223	19.6%	4.5%	35.8%	15.7%	0.55	0.28
Mean		**19.2%**	**11.3%**	**18.3%**	**15.2%**	**0.54**	**0.34**
		WFE:	**59.2%**	**WFE:**	**83.2%**	**WFE:**	**64.0%**

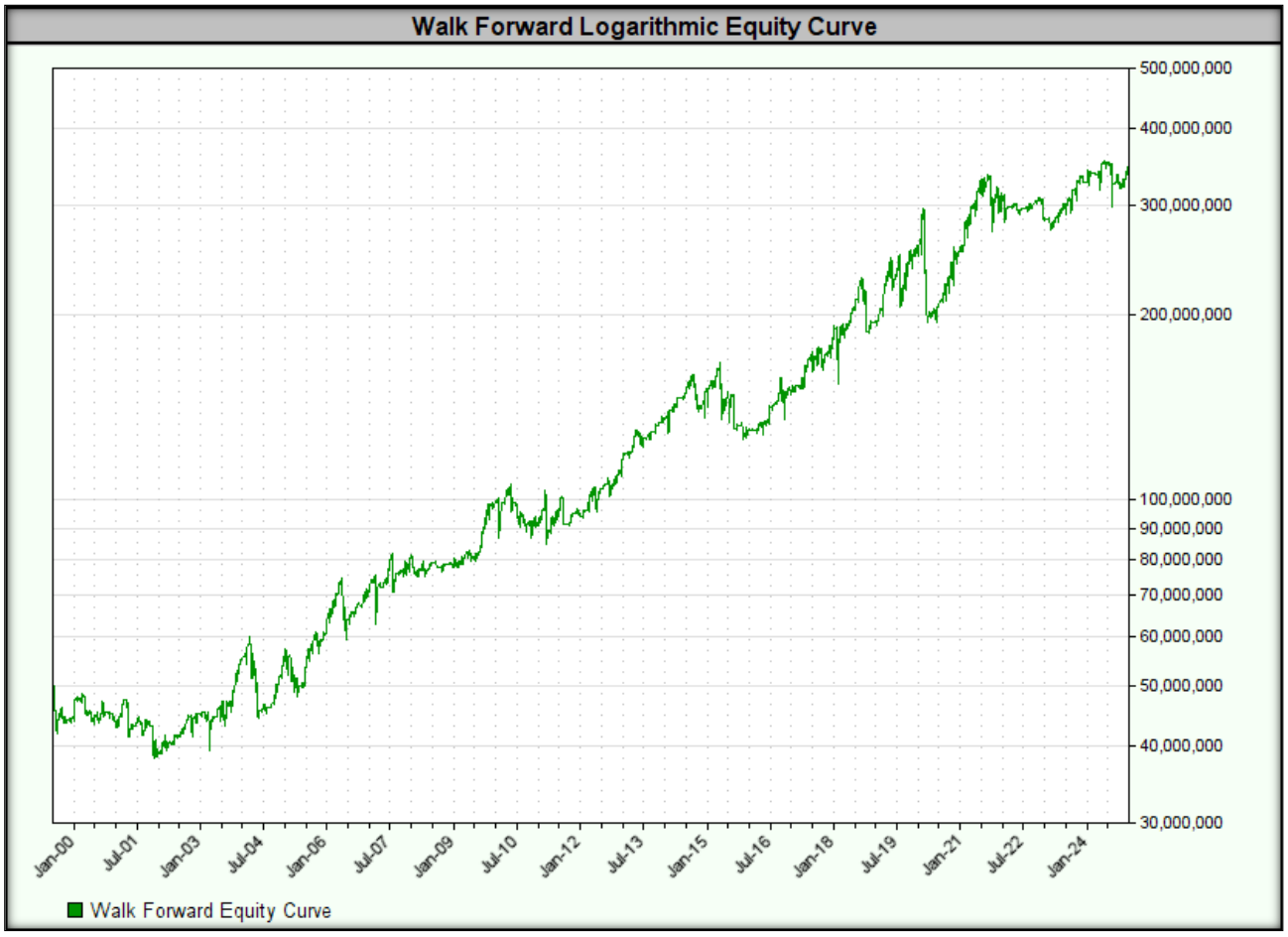
4. **Walk Forward Optimization: 1644 days; Walk Forward Out-of-sample: 548 days**

Below are **the results of Walk Forward Analysis (WFA) for the 1644/548 day combination.**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
339,633,557	7.81%	0.22	0.37	34.85%	51.75	2,181

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



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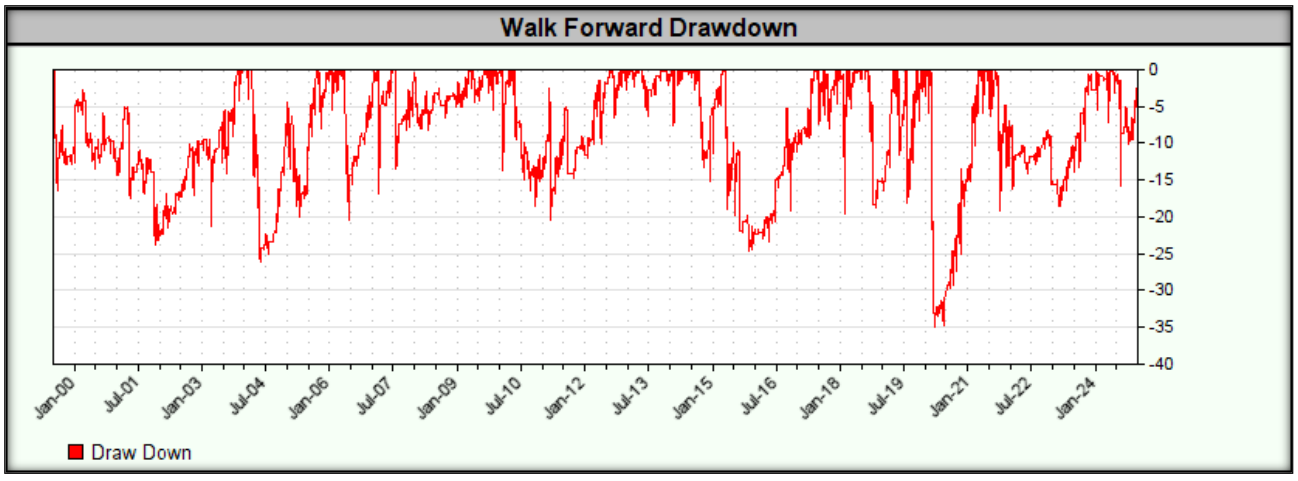


Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	1644	CAGR%		Max DD		MAR	
WFA:	548	Projections	Real	Projections	Real	Projections	Real
19990705	20001229	16.2%	-9.3%	7.3%	16.4%	2.23	- 0.57

20010101	20020702	19.5%	-2.5%	16.1%	19.7%	1.21	- 0.13
20020703	20040101	16.2%	21.3%	16.0%	13.1%	1.01	1.62
20040102	20050701	13.4%	-1.1%	16.0%	26.1%	0.84	- 0.04
20050704	20070101	9.1%	19.0%	15.8%	20.5%	0.57	0.93
20070102	20080702	14.9%	7.8%	15.4%	16.9%	0.97	0.46
20080703	20100101	11.4%	16.2%	13.7%	5.6%	0.83	2.91
20100104	20110701	19.3%	-3.6%	12.8%	20.4%	1.50	- 0.17
20110704	20130101	15.3%	15.4%	9.6%	10.2%	1.59	1.51
20130102	20140703	19.6%	18.3%	10.0%	7.7%	1.96	2.38
20140704	20160101	24.3%	-9.0%	10.9%	24.7%	2.22	- 0.36
20160104	20170703	21.9%	16.7%	19.0%	14.6%	1.15	1.14
20170704	20190102	21.0%	12.5%	17.2%	19.6%	1.22	0.64
20190103	20200703	23.7%	4.4%	21.3%	34.9%	1.11	0.13
20200706	20211231	24.0%	30.5%	32.7%	19.2%	0.73	1.59
20220103	20230704	23.2%	-2.1%	32.8%	11.9%	0.71	- 0.18
20230705	20241231	12.2%	8.8%	24.2%	15.7%	0.51	0.56
Mean		**18.0%**	**8.4%**	**17.1%**	**17.5%**	**0.55**	**0.24**
		WFE:	**46.9%**	**WFE:**	**102.2%**	**WFE:**	**44.1%**

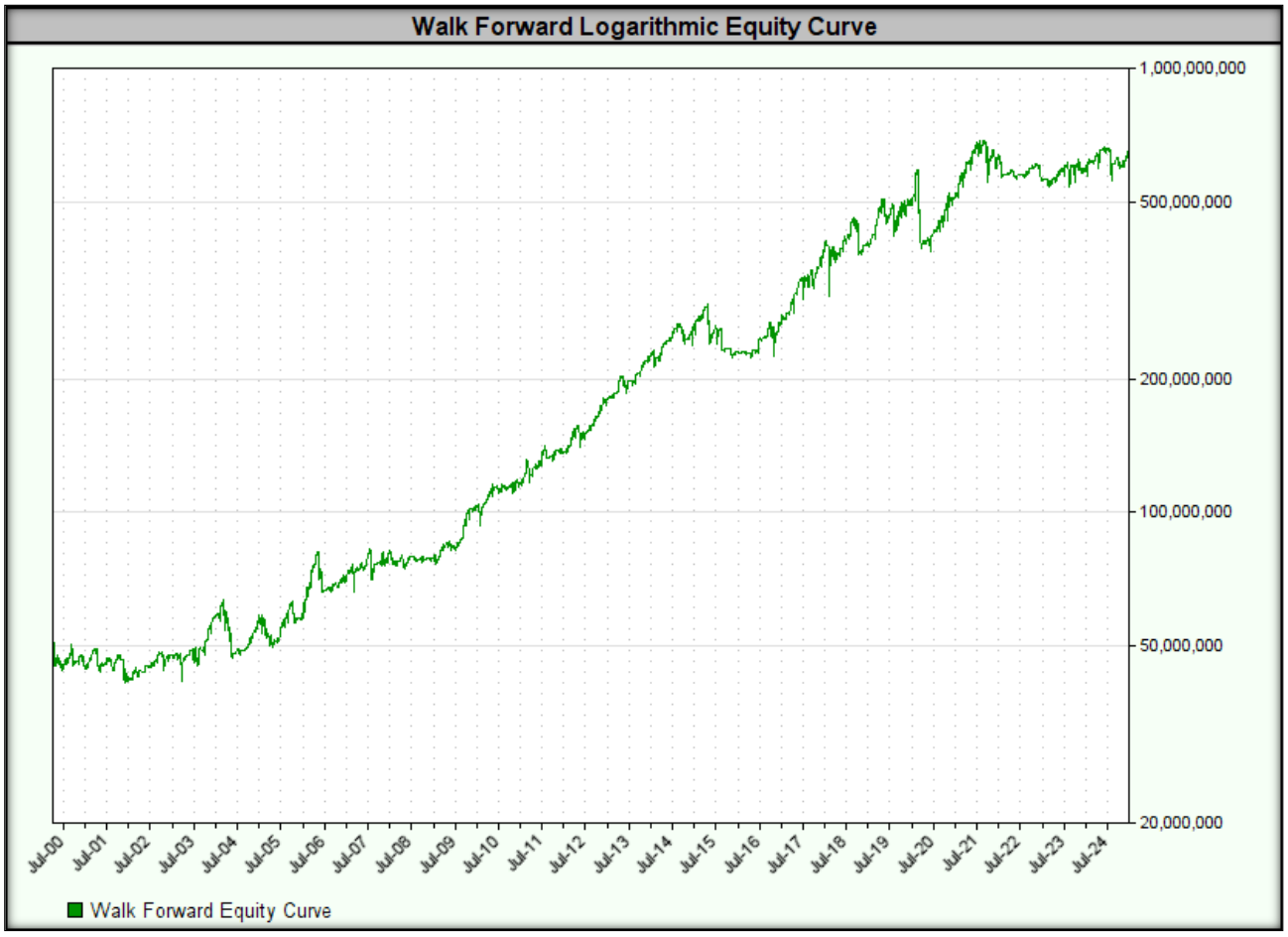
5. **Walk Forward Optimization: 1918 days; Walk Forward Out-of-sample: 548 days**

Below are **the results of Walk Forward Analysis (WFA) for the 1918/548 day combination.**

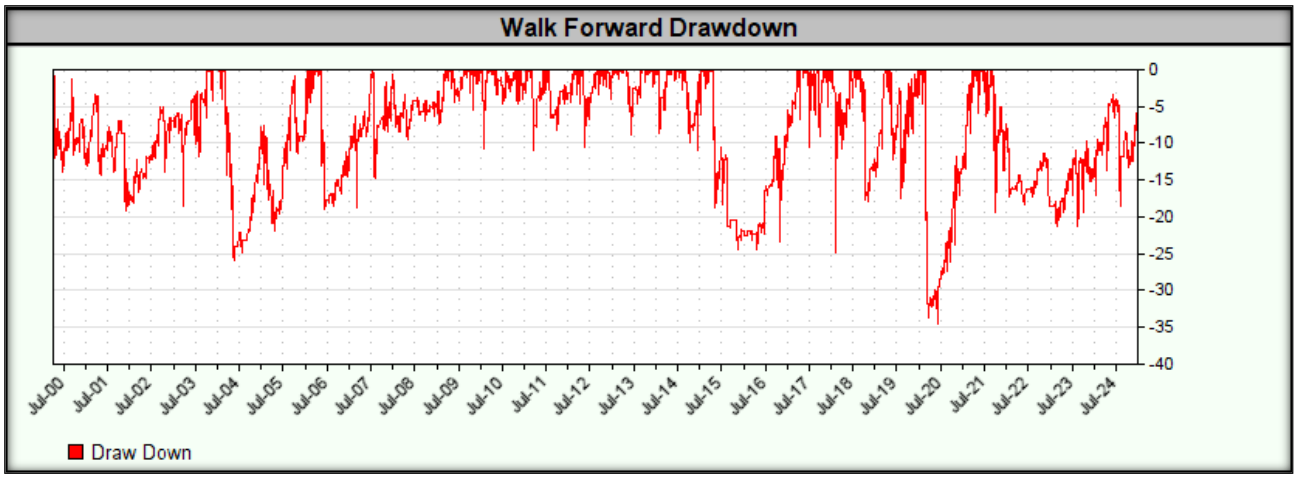
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
635,954,168	10.82%	0.31	0.50	34.50%	41.82	2,214

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	1918	CAGR%		Max DD		MAR	
WFA:	548	Projections	Real	Projections	Real	Projections	Real
20000403	20011001	27.4%	-3.2%	16.1%	14.4%	1.71	- 0.22

20011002	20030402	18.1%	-1.7%	16.8%	14.2%	1.07	- 0.12
20030403	20041001	15.0%	4.7%	16.0%	25.8%	0.93	0.18
20041004	20060331	11.5%	32.2%	31.9%	15.5%	0.36	2.08
20060403	20071002	13.6%	1.7%	16.2%	18.9%	0.84	0.09
20071003	20090402	14.6%	5.9%	17.0%	8.9%	0.86	0.66
20090403	20101001	10.1%	22.5%	13.7%	10.8%	0.73	2.08
20101004	20120402	19.0%	22.2%	14.4%	10.9%	1.32	2.03
20120403	20131002	16.8%	21.5%	10.7%	10.5%	1.57	2.05
20131003	20150403	20.4%	25.4%	10.6%	11.0%	1.93	2.30
20150406	20160930	22.4%	-5.3%	11.0%	24.4%	2.03	- 0.22
20161003	20180403	30.3%	23.9%	24.4%	24.8%	1.24	0.96
20180404	20191003	28.0%	18.0%	23.6%	17.9%	1.18	1.01
20191004	20210402	24.3%	17.5%	21.3%	34.5%	1.14	0.51
20210405	20221003	29.2%	-0.6%	33.7%	19.4%	0.87	- 0.03
20221004	20240403	18.8%	4.4%	32.8%	11.6%	0.57	0.38
20240404	20241231	13.2%	0.2%	24.2%	15.7%	0.55	0.01
Mean		**19.6%**	**11.1%**	**19.7%**	**17.0%**	**0.58**	**0.32**
		WFE:	**57.0%**	**WFE:**	**86.5%**	**WFE:**	**55.6%**

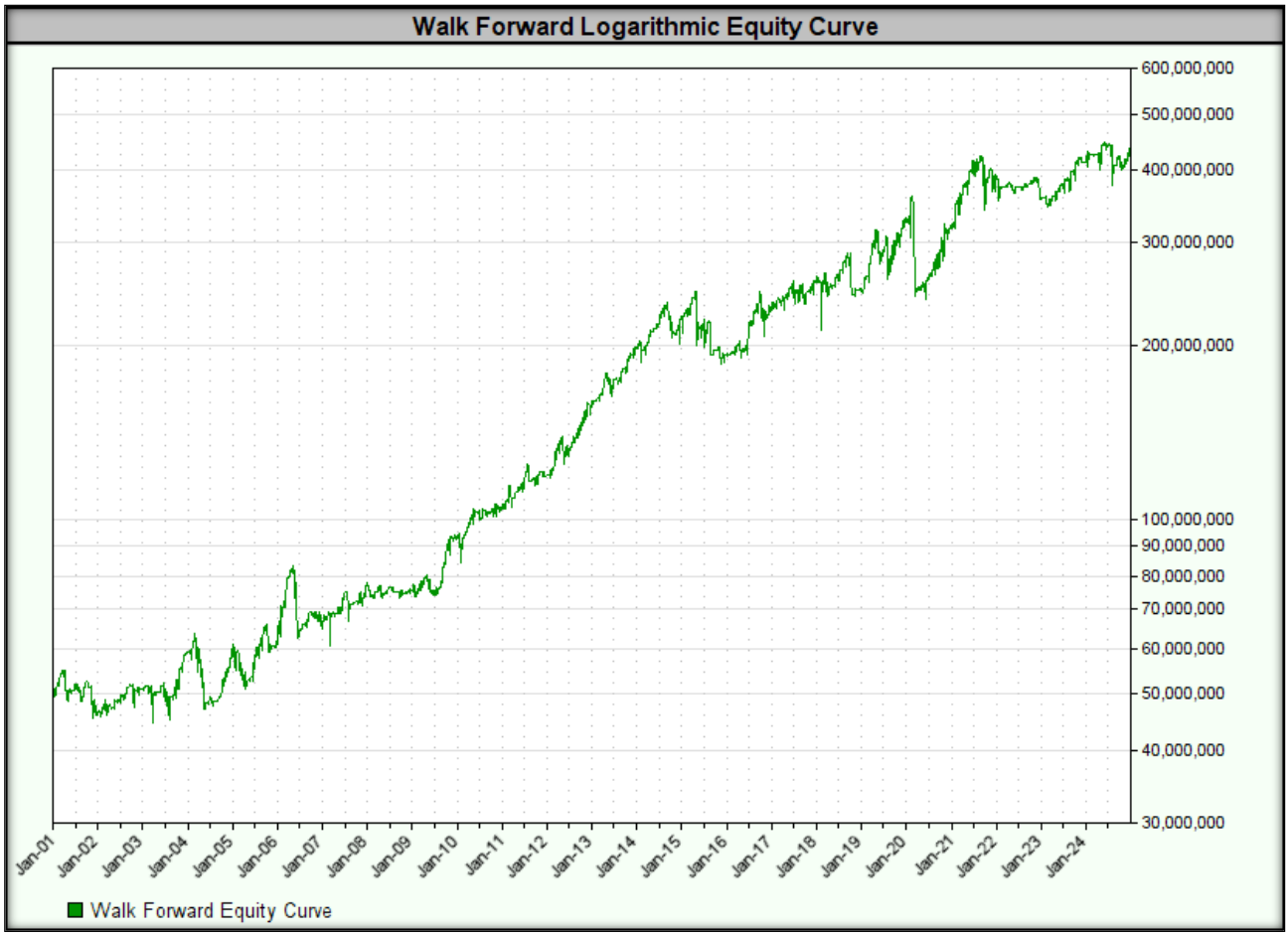
6. **Walk Forward Optimization: 2192 days; Walk Forward Out-of-sample: 548 days**

Below are **the results of Walk Forward Analysis (WFA) for the 2192/548 day combination.**

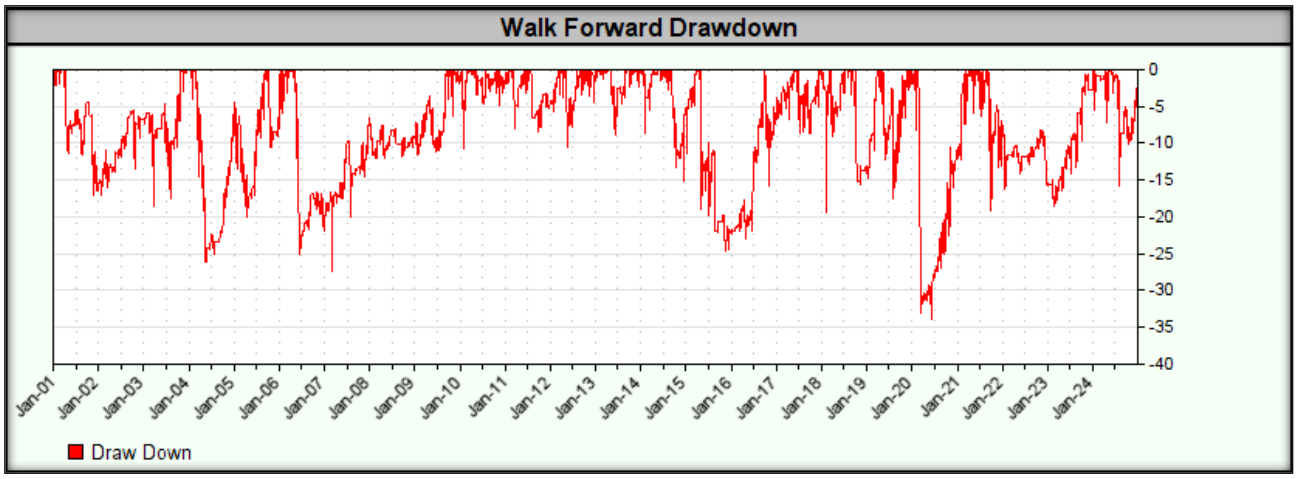
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Walk Forward Summary Performance						
Ending Balance	CAGR%	MAR	Annual Sharpe	Max Total Equity DD	Longest Drawdown	# Trades
427,777,003	9.36%	0.28	0.43	33.85%	40.08	2,181

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.



Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Optimization:	2192	CAGR%		Max DD		MAR	
WFA:	548	Projections	Real	Projections	Real	Projections	Real
20010101	20020702	21.0%	-1.8%	16.6%	17.1%	1.27	- 0.11

20020703	20040101	15.0%	13.9%	15.7%	13.8%	0.95	1.00
20040102	20050701	17.5%	-1.4%	16.0%	26.1%	1.09	- 0.05
20050704	20070101	9.3%	8.1%	23.8%	25.1%	0.39	0.32
20070102	20080702	9.2%	11.5%	15.7%	12.8%	0.59	0.89
20080703	20100101	12.6%	14.0%	15.8%	7.8%	0.80	1.80
20100104	20110701	12.6%	13.9%	13.7%	10.8%	0.92	1.29
20110704	20130101	18.4%	25.5%	14.1%	10.5%	1.31	2.43
20130102	20140703	17.9%	24.2%	10.7%	8.9%	1.68	2.73
20140704	20160101	22.6%	-8.5%	10.9%	24.7%	2.07	- 0.34
20160104	20170703	19.0%	16.6%	19.0%	15.8%	1.00	1.05
20170704	20190102	21.1%	2.1%	17.2%	19.3%	1.23	0.11
20190103	20200703	26.1%	3.3%	23.6%	33.9%	1.10	0.10
20200706	20211231	20.1%	30.5%	32.7%	19.2%	0.62	1.59
20220103	20230704	27.1%	-2.1%	32.8%	11.9%	0.83	- 0.18
20230705	20241231	12.0%	8.8%	24.2%	15.7%	0.50	0.56
Mean		**17.6%**	**9.9%**	**18.9%**	**17.1%**	**0.54**	**0.29**
		WFE:	**56.3%**	**WFE:**	**90.4%**	**WFE:**	**54.6%**

7. Walk Forward Analysis Summary

The above analysis shows that **regardless of the adopted combination of optimization and testing window lengths,** the **WFE results are very good:**

- **WFE for CAGR% remains around 55%-60%,** which indicates moderate performance of the strategy in real-world conditions. **One of the six tests had WFE below 50%.**
- **The WFE for drawdown remains around 90%-100%,** which means that the strategy does not lose significant stability outside of the optimization period.

Apart from the tests **for the 1644/548 day combination,** the results are very close to each other, which is good news.

Considering both **MAR** and **WFE,** the best results were achieved for **the combination of 1460/365 days** (1460 days of optimization, 365 days of testing).

Below is **a comparison of the WFA test results for the 1460/365 combination with the results of the strategy using the optimized parameters from Step 4:**

Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

	WFA	Optimized
CAGR%	10.4%	8.4%
MAR Ratio	0.31	0.29
Max Drawdown	33.1%	29.2%

The results are similar, which is a positive sign – it means that the strategy remains stable **and** independent of **overfitting to historical data.**

Step 6: Using the strategy in real time

After **extensive testing, implementing a real-time** trading strategy becomes **relatively easy.** Buy/sell signals and **stop loss orders are generated automatically** by the computer based on previously established rules and formulas.

The most important element of **strategy implementation** is **consistent enforcement of all signals, without exceptions. How Larry Williams noted:** *"Trading strategies work. Traders do not."*

Before making **a final decision to implement a strategy,** it is necessary to check **whether it really adds value** to the results of the entire portfolio. It does not make sense to implement a strategy that **generates similar signals** or **is characterized by a similar course of the equity curve.**

Key criteria for evaluating the strategy before implementation:

1. **Daily Return Correlation**
   - The **lower the correlation** with other strategies, the better.
   - **Optimal values:** Correlation **close to zero or negative.**
2. **Reducing maximum drawdown**
   - If adding a strategy to a portfolio results in **a lower maximum drawdown,** this is **a strong positive signal.**
3. **Objective Function Improvement (MAR)**
   - If adding a strategy causes **the MAR to increase,** this indicates that **it has added value** to the portfolio.
4. **Better results in Monte Carlo simulation**
   - Monte Carlo simulation determines the potential **maximum drawdown.**
   - If Monte Carlo results **improve** after adding a strategy, this is **a strong positive signal.**

The above elements are often interrelated – usually **all of them are met** or **none of them are met.**

Once you decide to add a strategy to your portfolio, **the question arises:** *Should you implement your strategy right away or is it better to wait?*

Some studies suggest **an incubation period** of **3-6 months,** during which:

- The strategy is **monitored** but **does not execute real transactions.**
- **Generated signals, positions and results** are observed to identify **potential anomalies.**

In our case, **the incubation period** lasts from the moment **the strategy is launched in a live environment** until **a drawdown occurs at a level of about half of the maximum drawdown** observed in historical data. **Only after reaching this threshold does the strategy begin to be used with real funds.**

Thanks to this:

- **We avoid investing real money in an untested environment.**
- **We wait for a drawdown to occur** before launching the strategy, which **reduces the risk of starting at an unfavorable moment.**

The final decision to fully implement it should be based on **thorough testing and analysis of the value added to the portfolio,** so that the strategy actually supports long-term investment goals and does not increase unnecessary risk.