



RSI PowerZone v.2

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.1 version of this strategy, the parameters have been optimized using The Grid technique Search. Although the strategy results on in-sample data are decent, the strategy failed the stability test in a wide range of optimized parameters. This means that the strategy loses its profitability and generates a significantly larger drawdown when tests are performed on suboptimal parameters. Therefore, it is not recommended to use it in real transactions.

Our goal is to have a strategy that remains **profitable and effective over a wide range of parameters**, because the market is a changing organism and the optimal parameters can change over different periods. **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."

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.

Even though the strategy **failed the parameter stability test**, based on the conclusions from the tests conducted so far, **version v.3 of the strategy will include elements whose lack was identified in the tests below.**



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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 (according to RSI), 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, after opening the first long position, the market continues to decline (according to RSI).
- **False signals in case of a dynamic trend change** – during periods of a rapid trend change, the RSI may generate losing signals.
- **loss order** – no protection in the event of a dynamic trend reversal, which can lead to large losses.
- **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 and lack of stop losses. Its application requires careful optimization and risk management, especially in volatile market conditions.



Step 2: Define investment principles

Below is the **pseudo code** 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 ($\text{Price} > \text{SMA-YY}$) 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 RSI drops below the HH2 level ($\text{HH2} < \text{HH1}$), an additional unit is purchased, which increases the exposure to 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 HH3 level.
- b. The close occurs at the opening price of the next day, after the signal is generated.

4. Loss Management:

- a. Loss orders, which means that potential losses are not limited by automatic closing of positions.
- b. This is an important consideration for risk management and requires discipline from the trader and the possible introduction of his own capital protection mechanisms.

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 selected 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** distant from the position opening point by **2 x ATR (40 days)**.



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.**

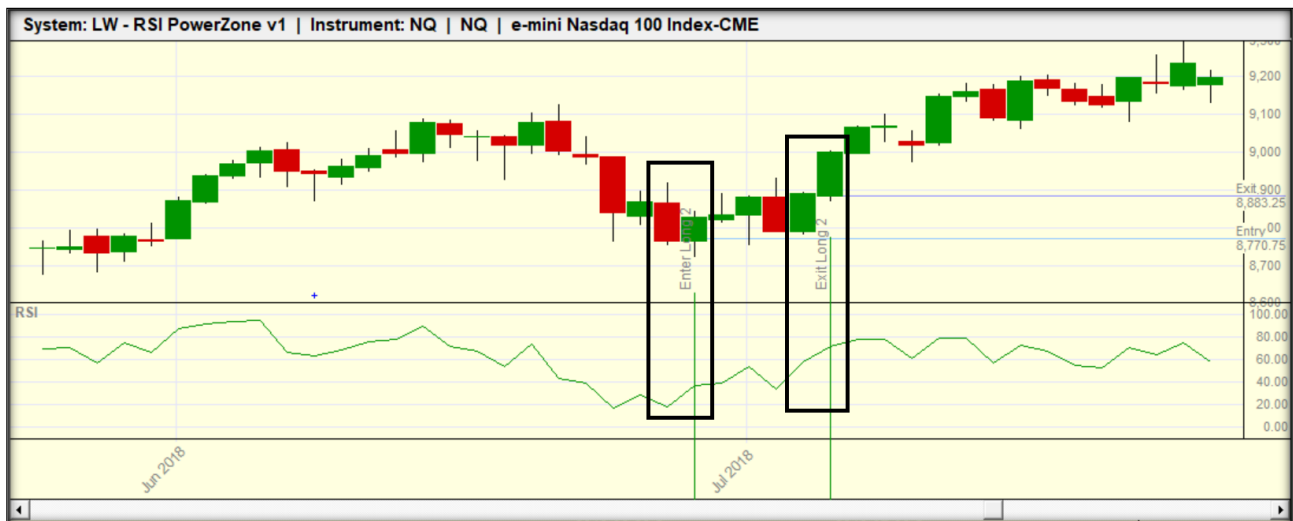
At this stage **it does not matter** whether the transactions are **profitable**, what **instrument was used** or whether they took place **recently** or **in the distant past**. The key is **to check whether the transactions are generated correctly** and in accordance with the assumptions described 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 **RSI dropped below 25**, which 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**.

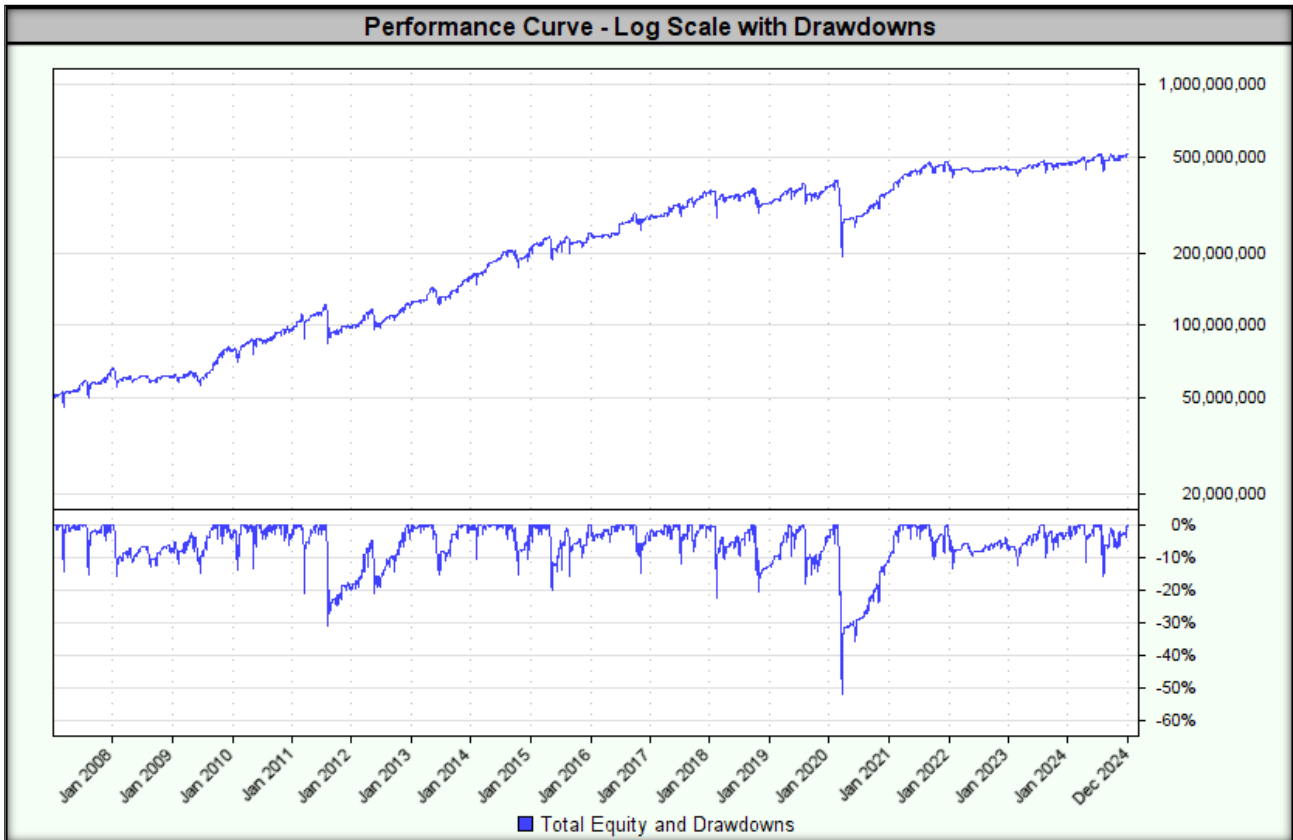
First of all, **we reject strategies that linearly lose capital**. If a strategy exhibits such a pattern, it is a clear signal that any parameter optimization does not make sense.

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 (1 unit):** 30;
- **RSI Entry Threshold (2 units):** 25;
- **RSI Exit Threshold (take profit):** 55;
- **Stop loss:** none;
- **Method of opening a position:** at the opening price of the next day;
- **Position size:** corresponding to the risk of 1.0% 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.



Indicators/Measures	Concluding a transaction at the opening price
CAGR%	13.8%
MAR Ratio	0.27
RAR%	14.9%
R-Cubed	0.56
Robust Sharpe Ratio	0.88
Max Drawdown	51.8%
Wins	71.6%
Losses	28.4%
Average Win%	0.49%
Average Loss %	0.77%
Win/ Loss Ratio	0.63
Average Trade Duration (days)	9
Percent Profit Factor	1.59
SQN	-
Number of transactions	1986

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**.



Step 4: Optimization and assessment of investment strategy stability

1. Stability across a wide range of optimized parameters

PowerZone v.2 Strategy in this version it assumes **optimization of parameters proposed by the creator of the strategy - Larry Connors**. We will optimize using **The Grid method Search**, which consists in **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:

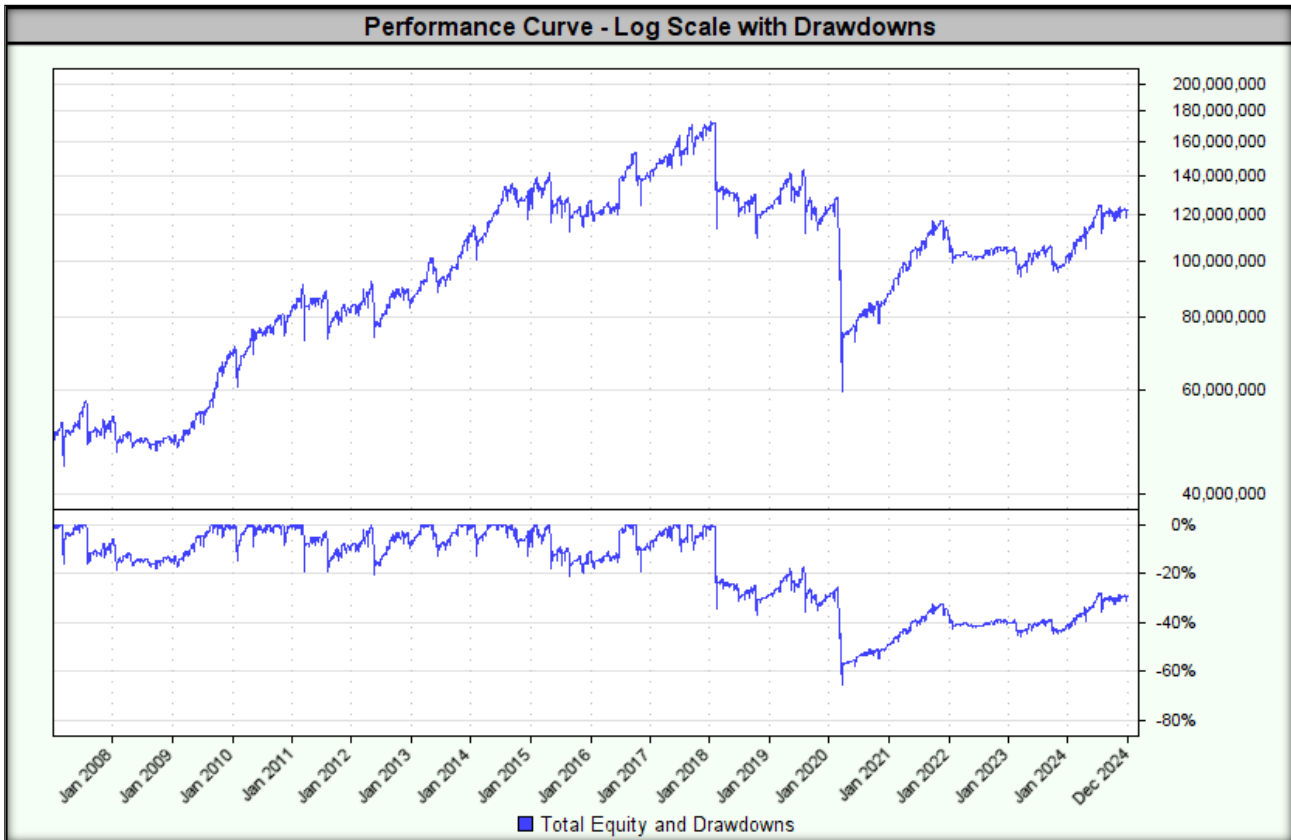
- **Moving average lengths (SMA): range 200-300 days (step: 20);**
- **RSI Lengths: Range 3-5 days (step: 1);**
- **RSI Entry Threshold (1 unit): range 24-36 (step: 2);**
- **RSI Entry Threshold (2 unit): range 20-30 (step: 2);**
- **RSI Exit Threshold (take profit): range 50-75 (step: 5).**

The lowest MAR value of 0.08 was achieved for the following parameters:

- **Length of the moving average (SMA): 140;**
- **RSI lengths: 3;**
- **RSI Entry Threshold (1 unit): 34;**
- **RSI Entry Threshold (2 units): 20;**
- **RSI Exit Threshold (take profit): 50.**

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
1693	140	3	34	20	50	\$121,957,429.56	5.08%	0.08	0.38	0.29	65.3%
3961	200	3	34	20	50	\$120,449,891.72	5.01%	0.08	0.37	0.27	61.3%
1694	140	3	34	20	55	\$150,765,155.60	6.32%	0.08	0.43	0.33	76.5%
2449	160	3	34	20	50	\$126,050,021.90	5.27%	0.08	0.39	0.30	63.1%
3206	180	3	34	20	55	\$149,980,438.64	6.29%	0.09	0.42	0.34	74.0%
2450	160	3	34	20	55	\$153,777,728.36	6.44%	0.09	0.43	0.34	74.8%
1699	140	3	34	22	50	\$137,592,169.05	5.79%	0.09	0.42	0.32	65.4%
2468	160	3	34	26	55	\$161,287,068.46	6.72%	0.09	0.44	0.34	75.7%
2416	160	3	32	20	65	\$210,267,904.69	8.31%	0.09	0.49	0.36	93.4%
3962	200	3	34	20	55	\$156,410,895.95	6.54%	0.09	0.43	0.33	73.5%
3967	200	3	34	22	50	\$129,304,409.85	5.42%	0.09	0.39	0.29	60.9%

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



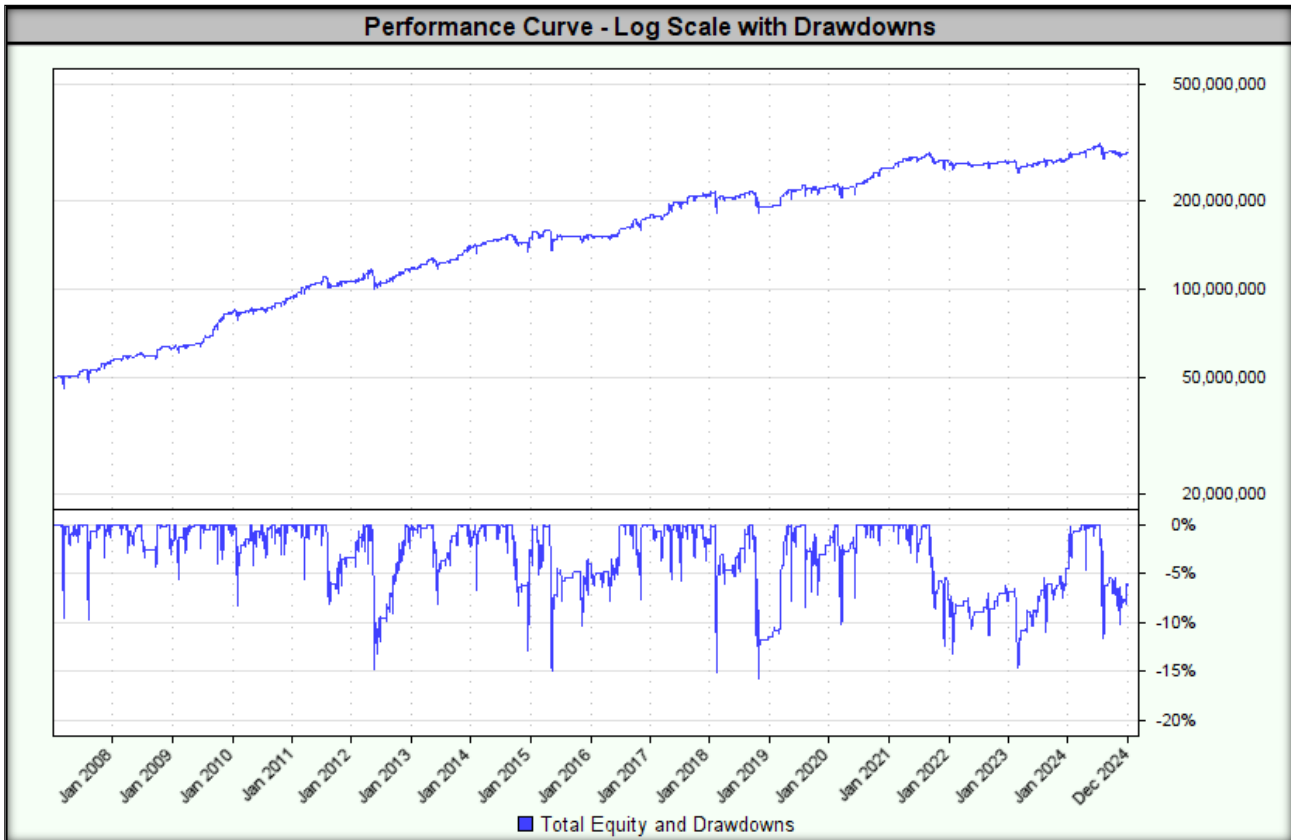
The highest MAR value of 0.66 was achieved for the following parameters:

- Length of the moving average (SMA): 100;
- RSI lengths: 5;
- RSI Entry Threshold (1 unit): 28;
- RSI Entry Threshold (2 units): 30;
- RSI Exit Threshold (take profit): 50.

The highest MAR value was accompanied by a drawdown of 15.7%.

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
607	100	5	28	30	50	\$293,895,190.27	10.34%	0.66	1.05	1.21	15.7%
601	100	5	28	28	50	\$294,030,030.62	10.34%	0.65	1.07	1.23	15.9%
589	100	5	28	24	50	\$268,347,107.01	9.79%	0.65	1.08	1.29	15.1%
595	100	5	28	26	50	\$286,089,083.77	10.18%	0.64	1.08	1.19	15.9%
583	100	5	28	22	50	\$248,168,694.17	9.31%	0.62	1.07	1.35	15.1%
308	100	4	26	26	55	\$380,670,270.60	11.94%	0.61	1.02	1.22	19.6%
320	100	4	26	30	55	\$378,219,168.06	11.90%	0.61	0.99	1.14	19.6%
302	100	4	26	24	55	\$374,945,745.30	11.84%	0.61	1.03	1.20	19.6%
314	100	4	26	28	55	\$372,208,135.20	11.80%	0.60	1.00	1.17	19.6%
577	100	5	28	20	50	\$222,723,062.01	8.65%	0.60	1.09	1.44	14.4%
362	100	4	30	20	55	\$441,194,539.94	12.86%	0.60	1.06	1.15	21.6%

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



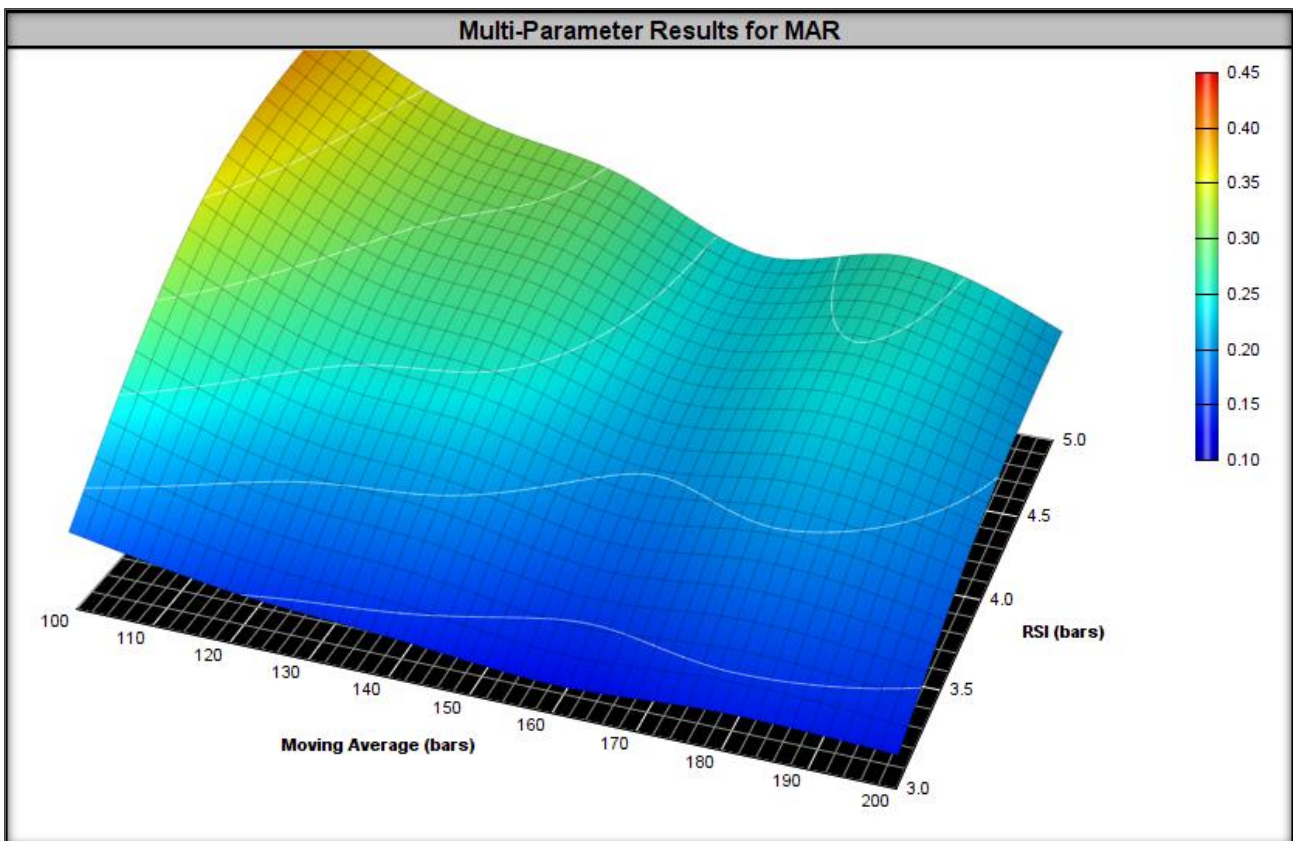
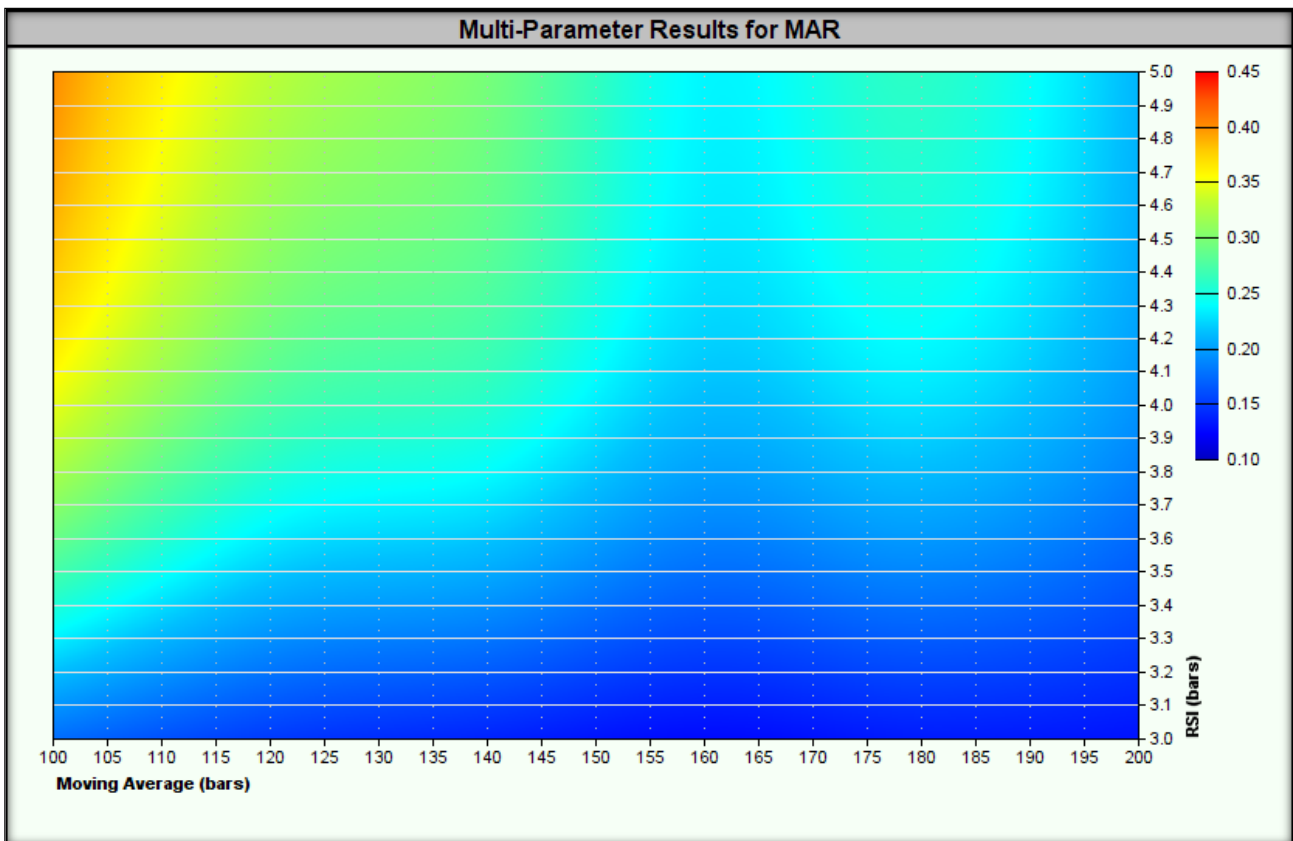
For all combinations of tested parameter ranges, **the highest drawdown was 100%!**

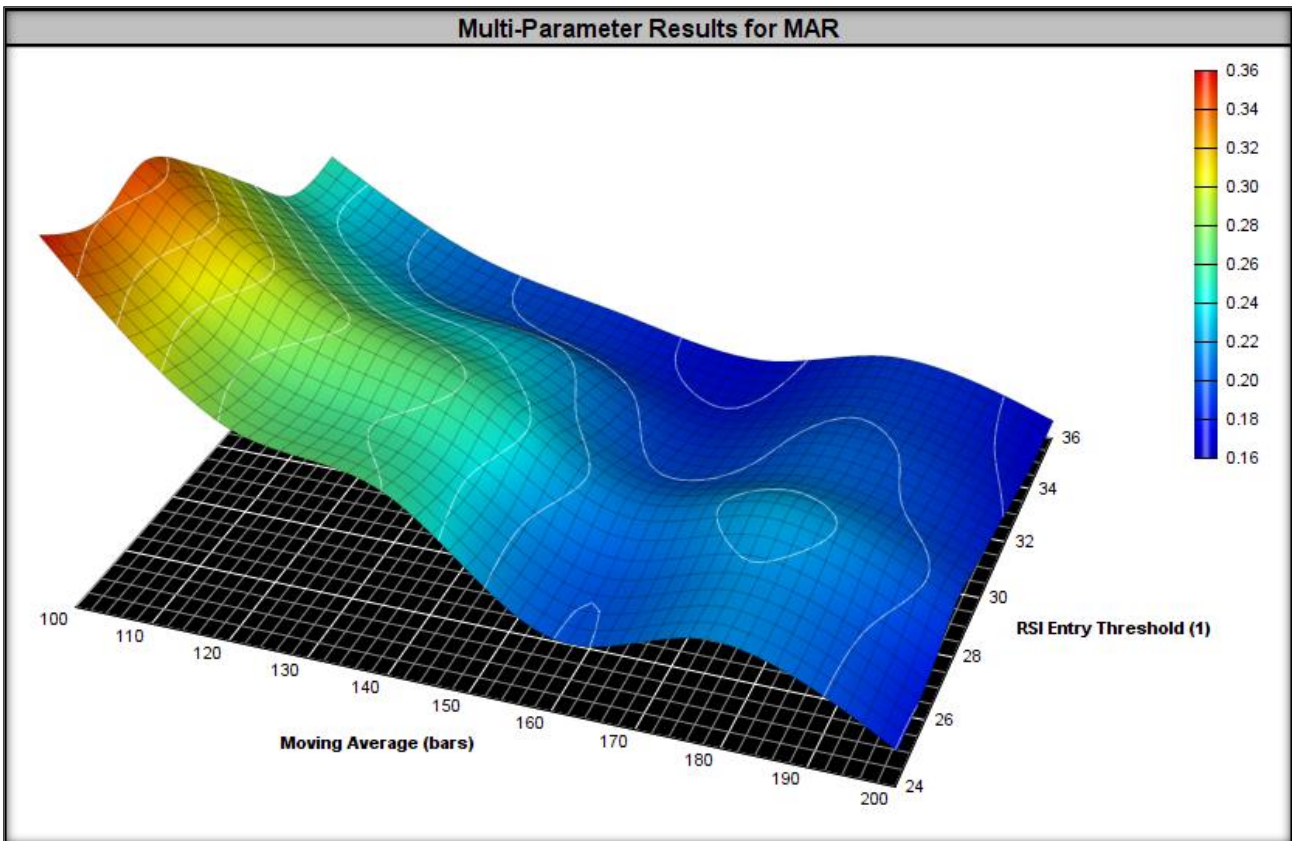
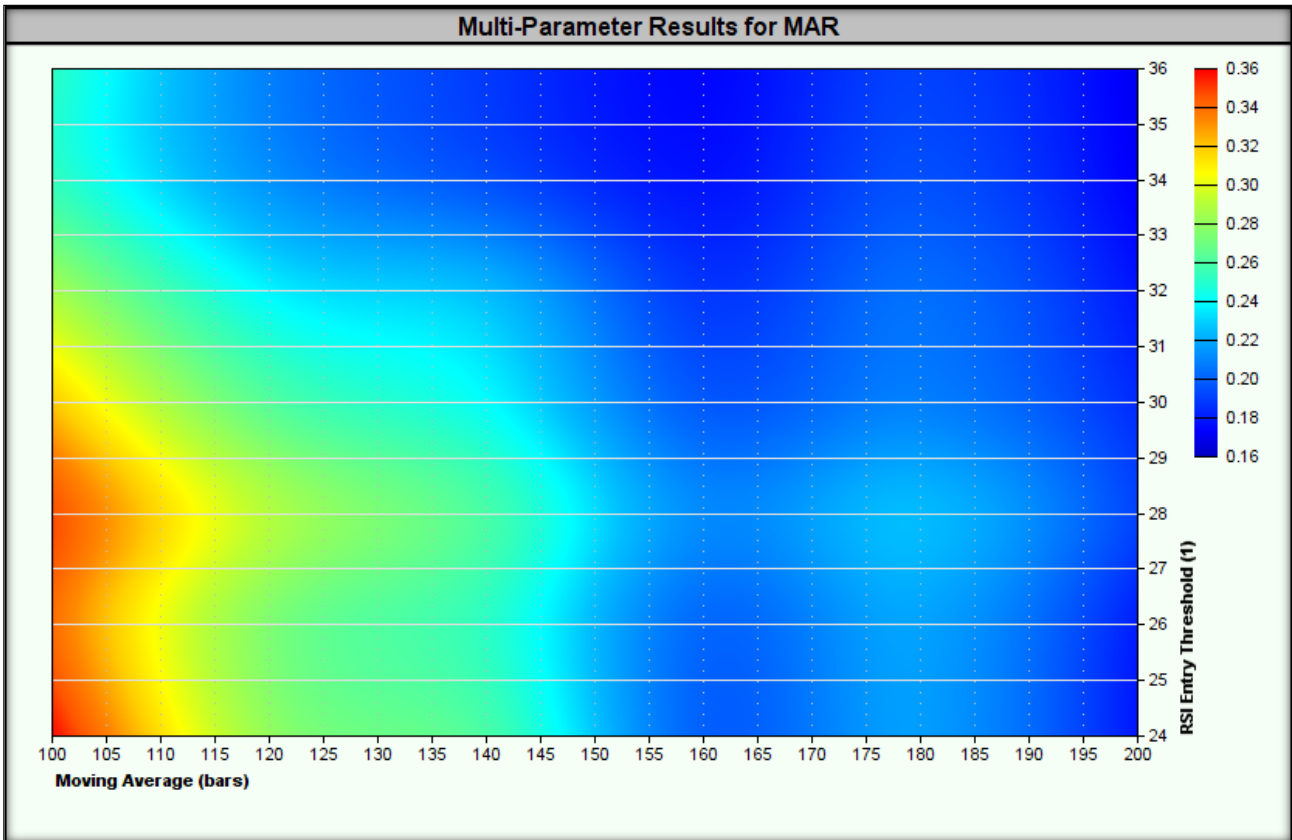
Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
2508	160	3	36	26	75	\$290,727,830.31	10.27%	0.10	0.51	0.37	100.0%
1728	140	3	34	30	75	\$418,237,115.55	12.53%	0.13	0.58	0.43	100.0%
966	120	3	34	28	75	\$350,181,141.55	11.42%	0.11	0.55	0.38	100.0%
1710	140	3	34	24	75	\$365,163,823.91	11.68%	0.12	0.56	0.42	100.0%
1746	140	3	36	24	75	\$355,040,636.17	11.51%	0.12	0.55	0.40	100.0%
2478	160	3	34	28	75	\$321,611,990.34	10.90%	0.11	0.53	0.39	100.0%
972	120	3	34	30	75	\$385,051,658.22	12.01%	0.12	0.56	0.40	100.0%
1716	140	3	34	26	75	\$359,811,159.26	11.59%	0.12	0.55	0.41	100.0%
1722	140	3	34	28	75	\$379,800,600.92	11.92%	0.12	0.56	0.41	100.0%
2484	160	3	34	30	75	\$355,426,393.73	11.51%	0.12	0.55	0.41	100.0%
2514	160	3	36	28	75	\$309,999,494.52	10.67%	0.11	0.52	0.38	100.0%

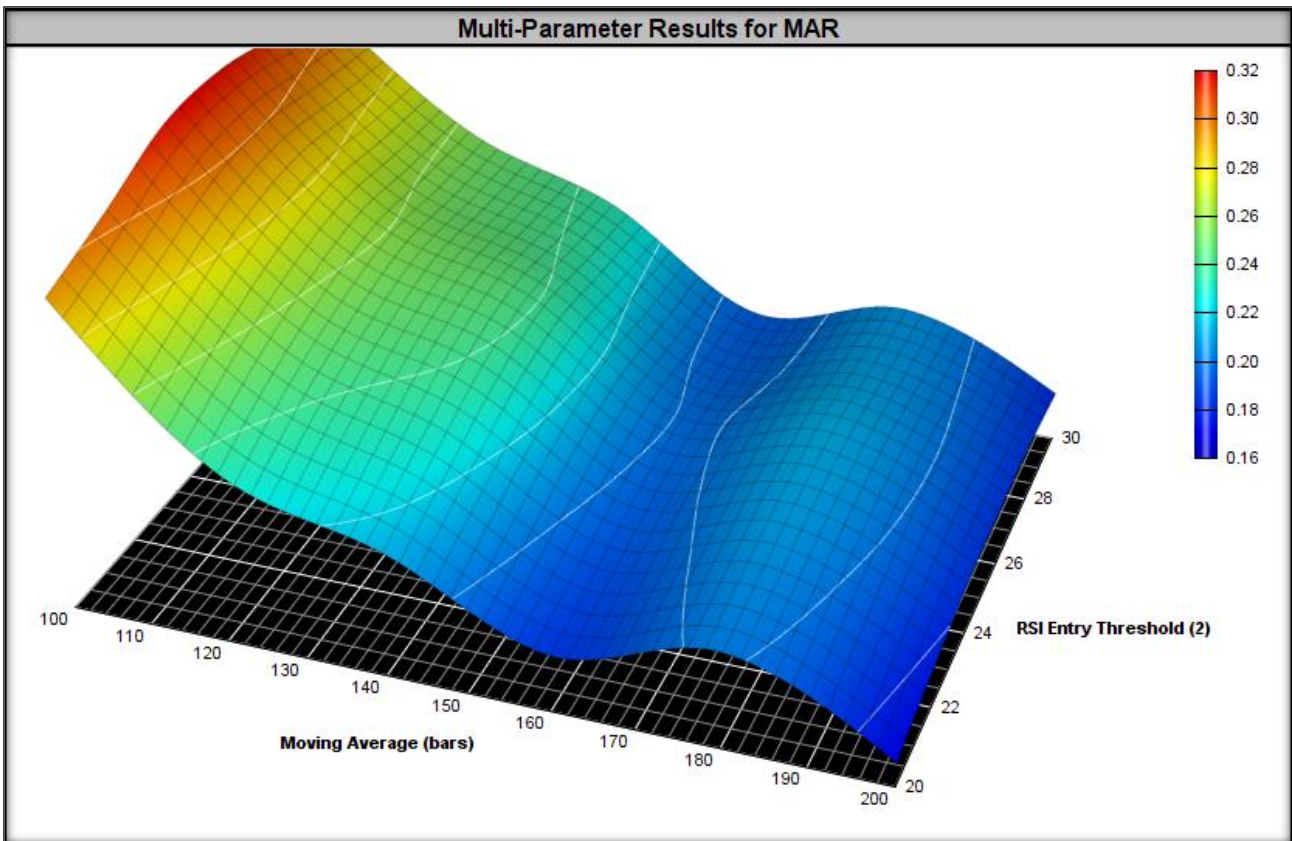
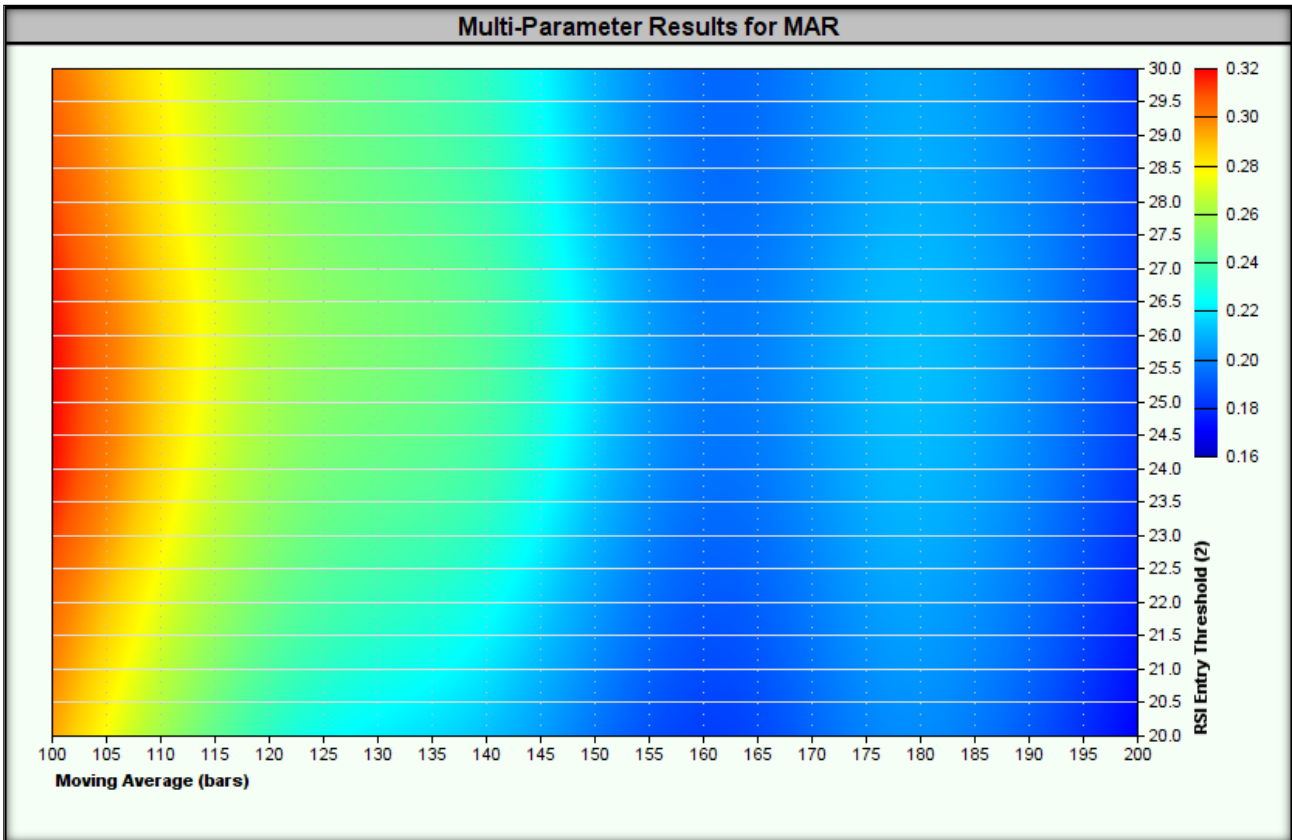
In summary, the strategy **failed the stability test** over a wide range of optimized parameters because:

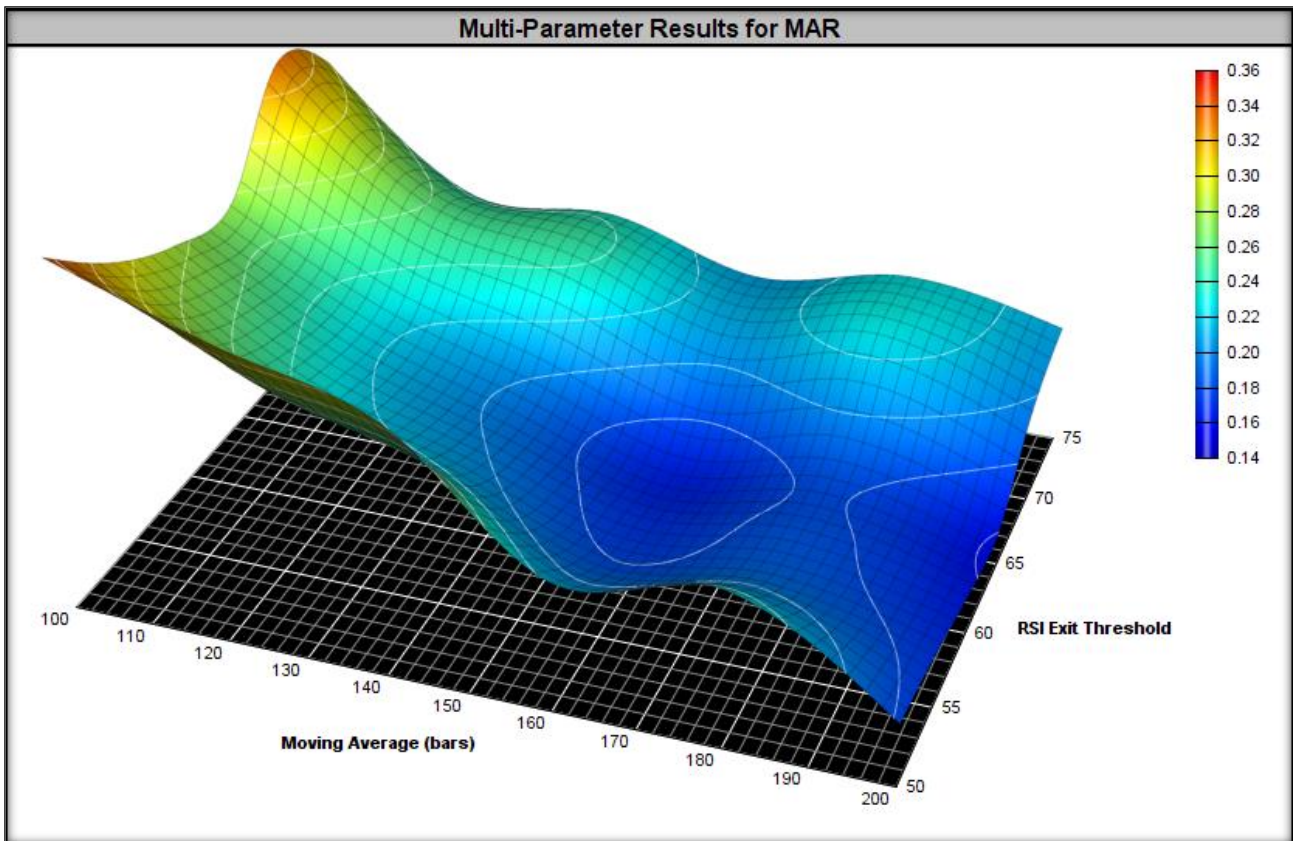
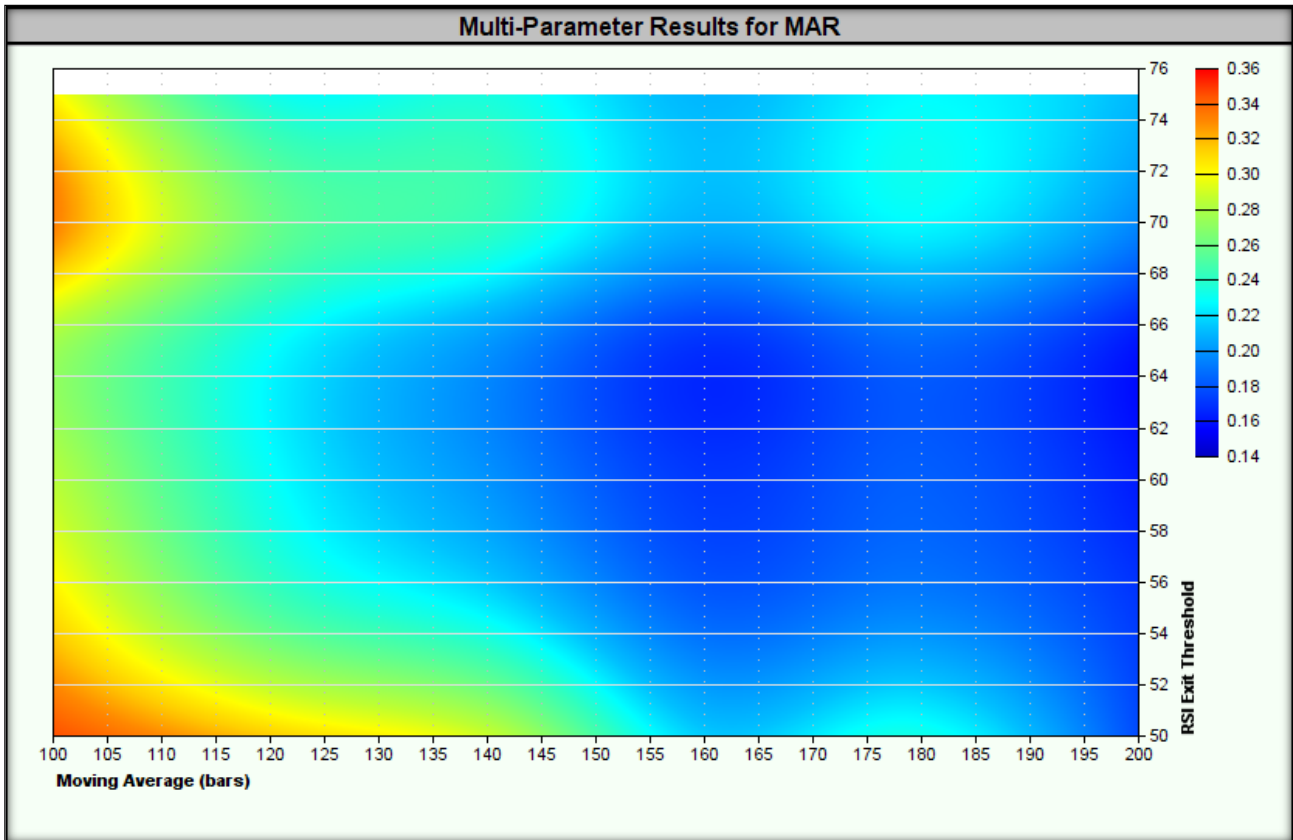
- **The maximum drawdown exceeded 250% of the drawdown value** for the result with the highest MAR (**100% vs. 15.7%**) – which means a high risk of deep capital drawdowns.

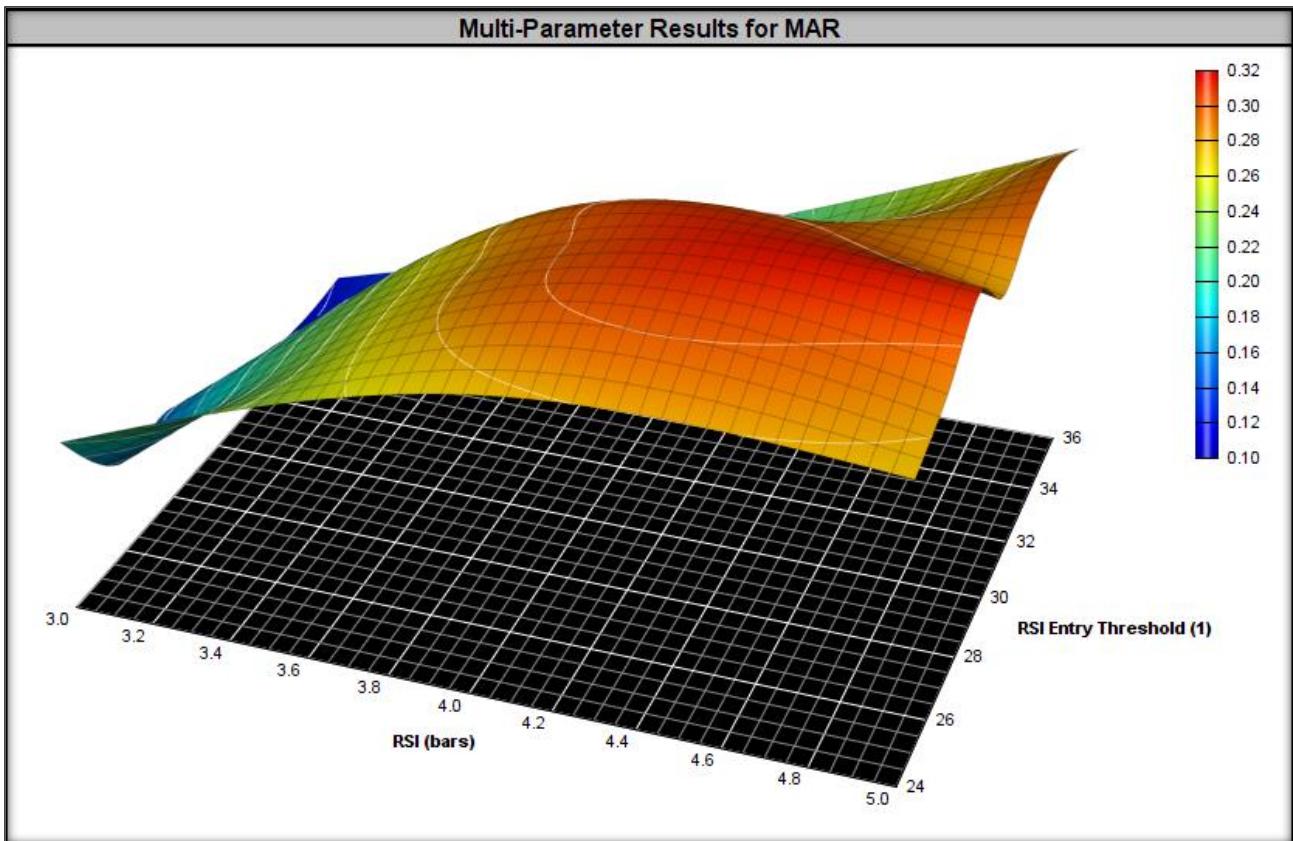
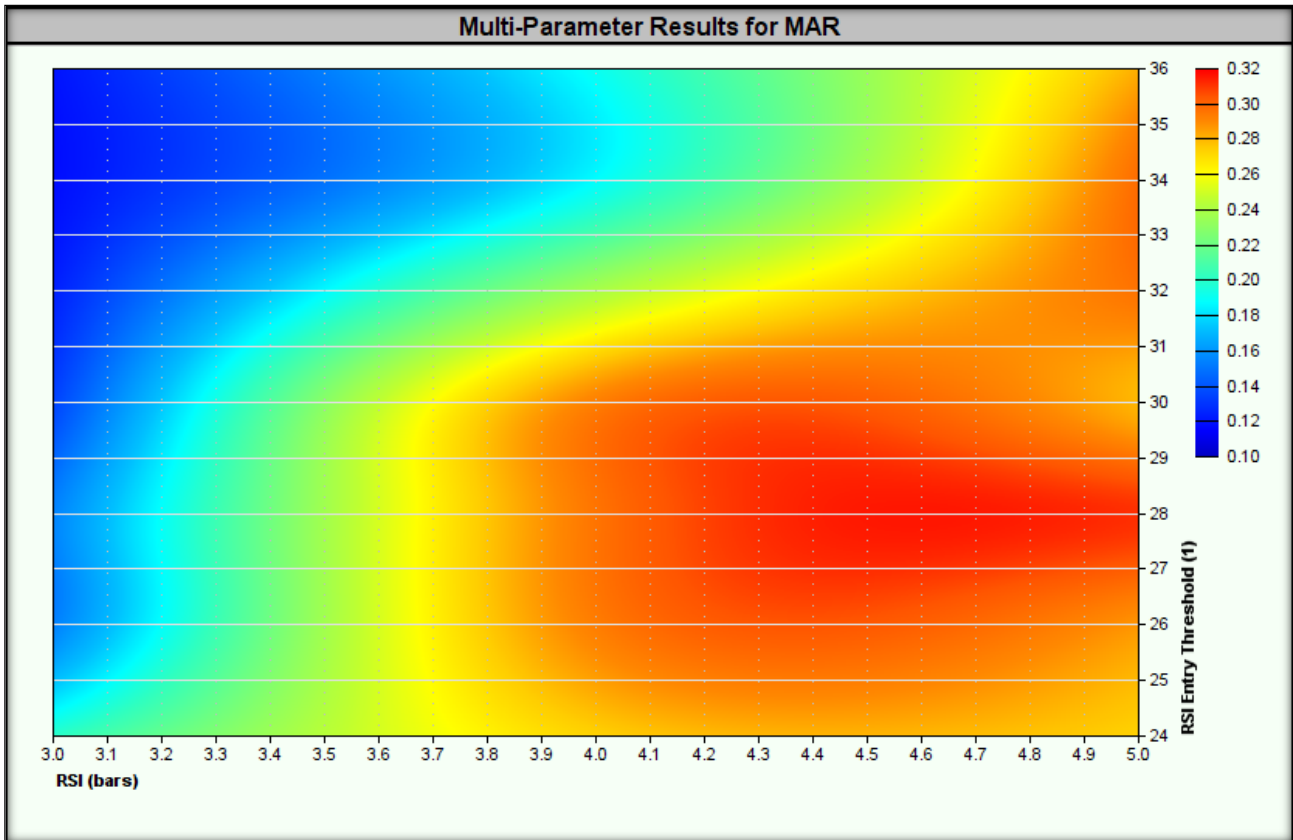
Therefore, **further testing of the strategy on these ranges is not justified**, because its use in real transactions is **highly doubtful**. Nevertheless, based on the obtained results (**heatmaps for the tested ranges, presented below**) we can draw conclusions for determining other, potential parameter ranges.

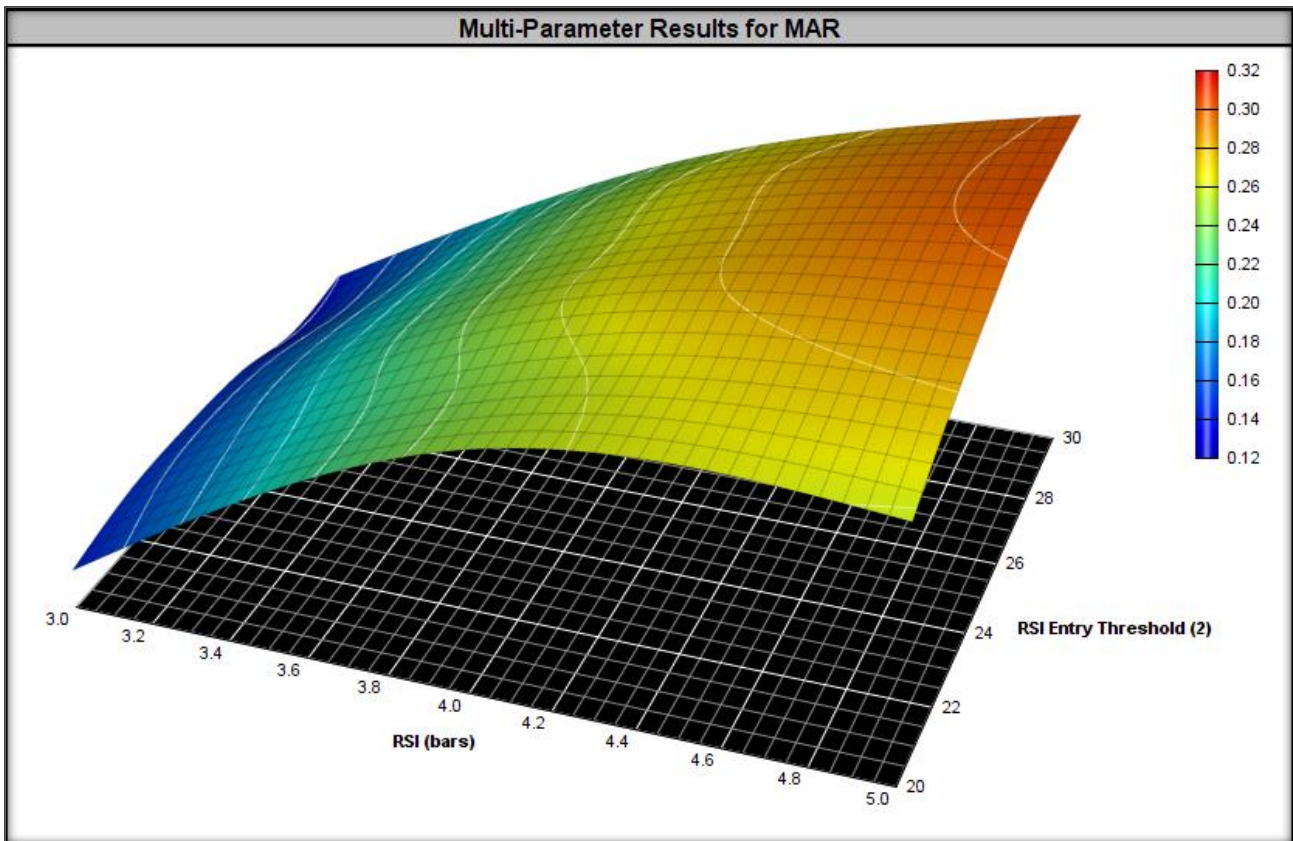
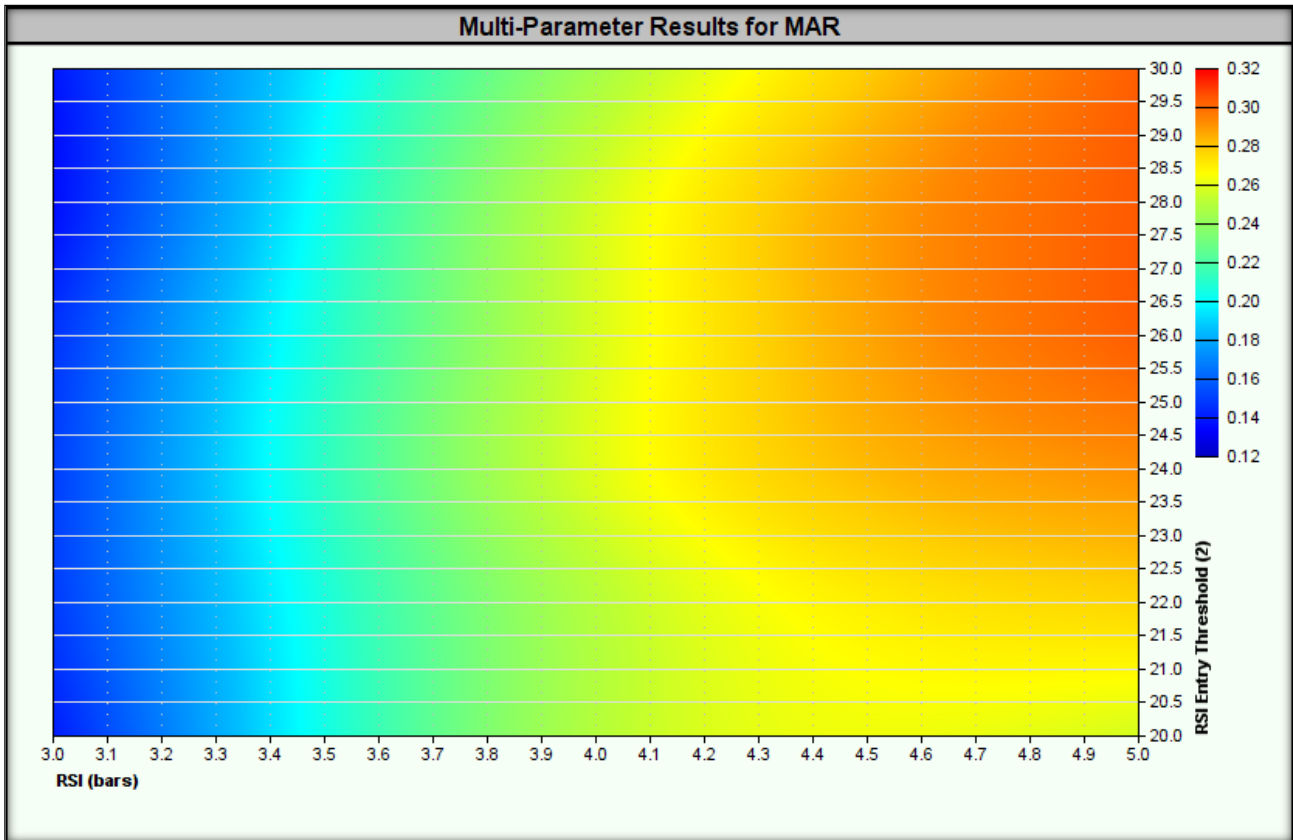


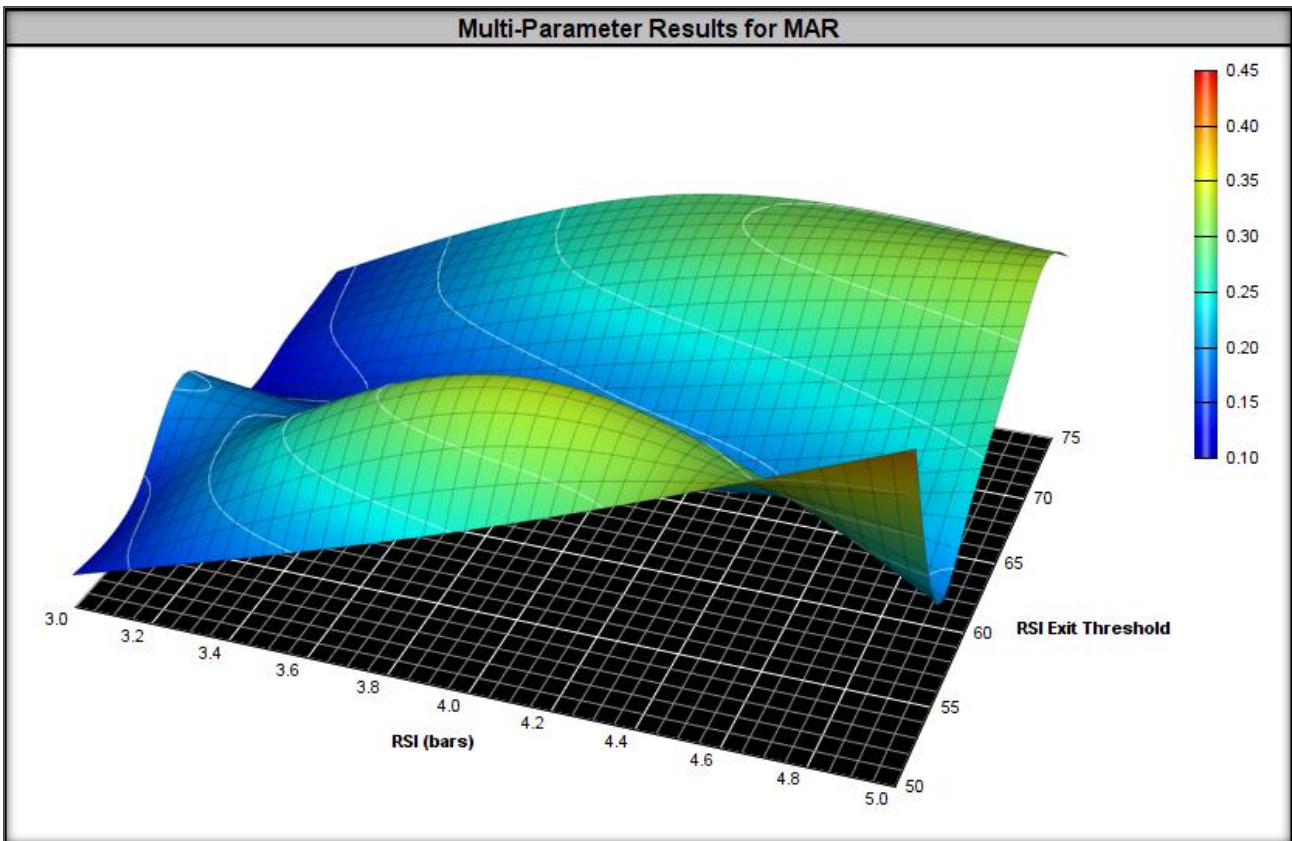
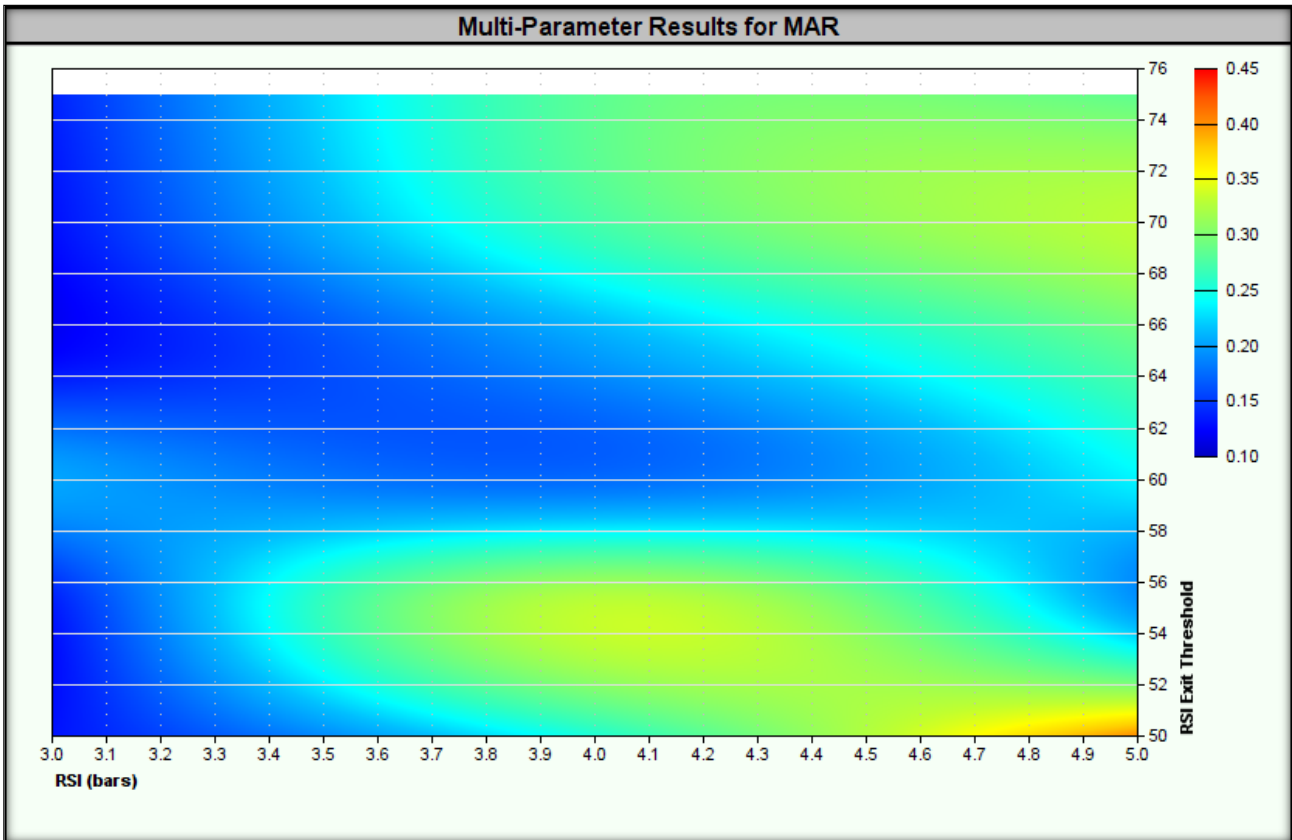


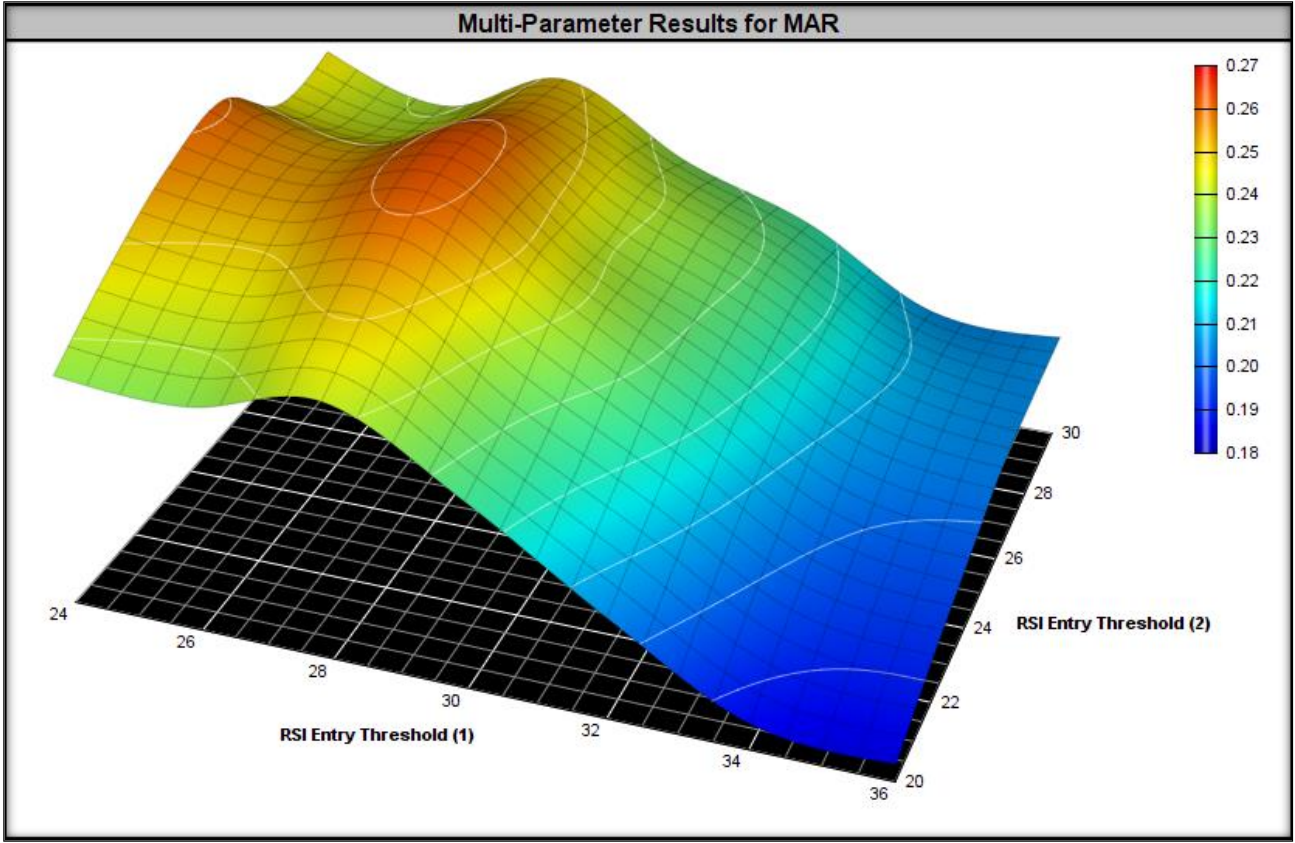
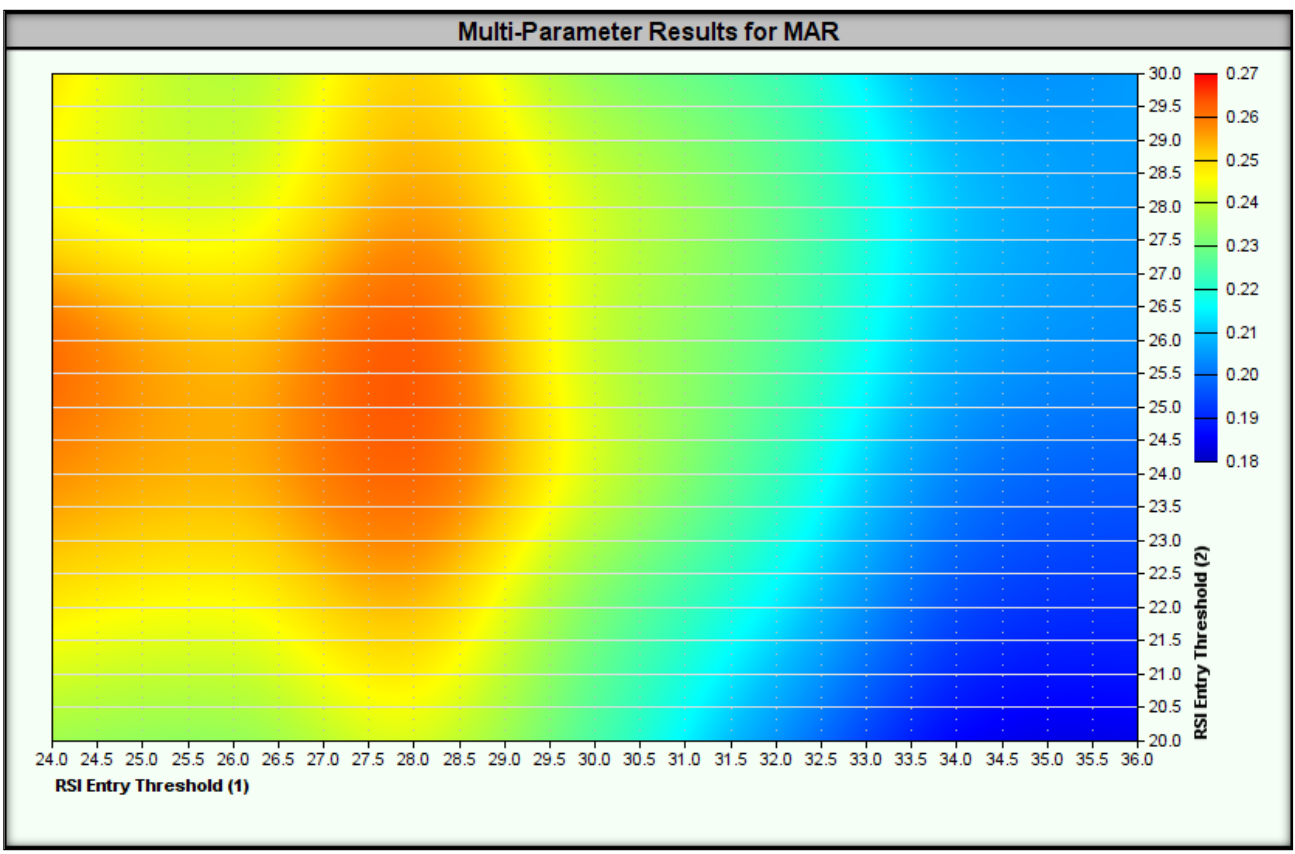


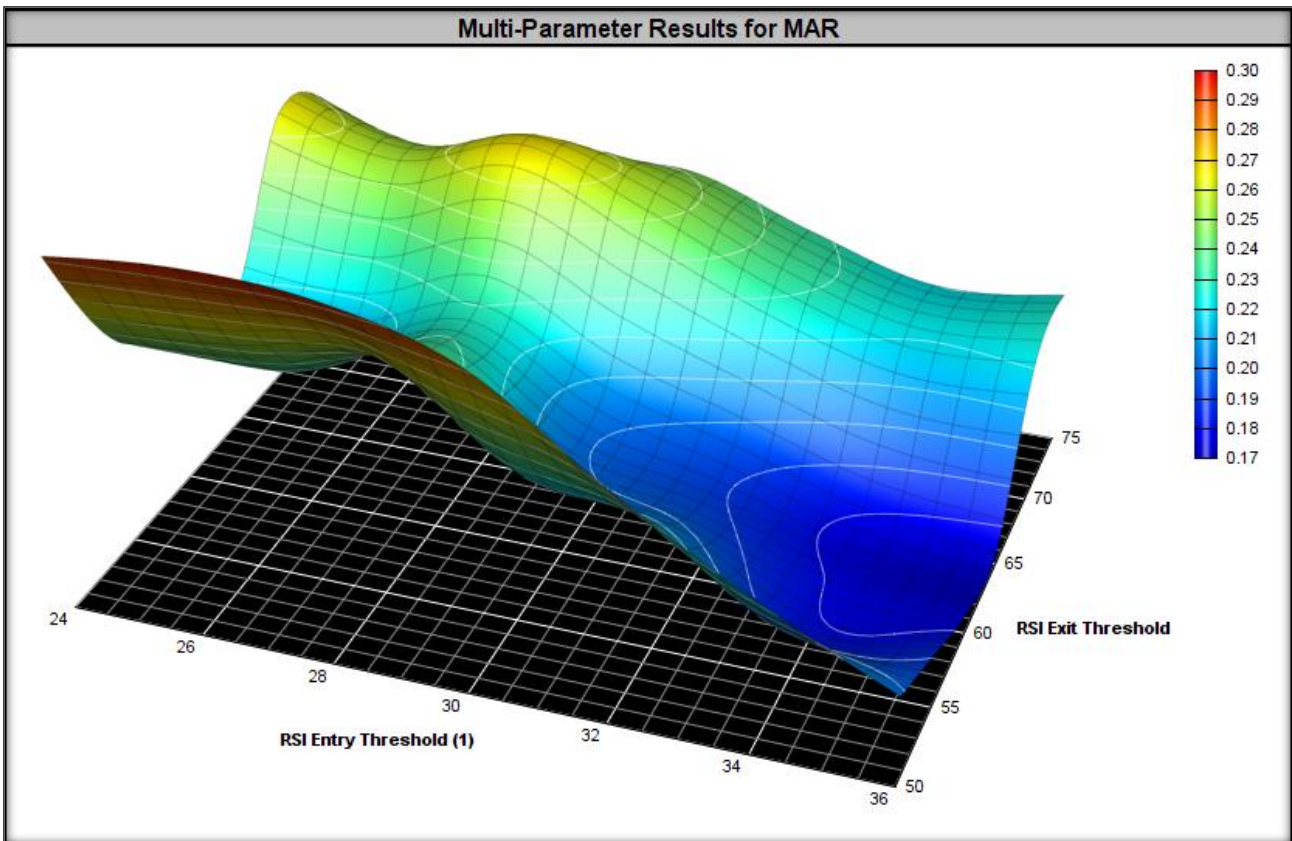
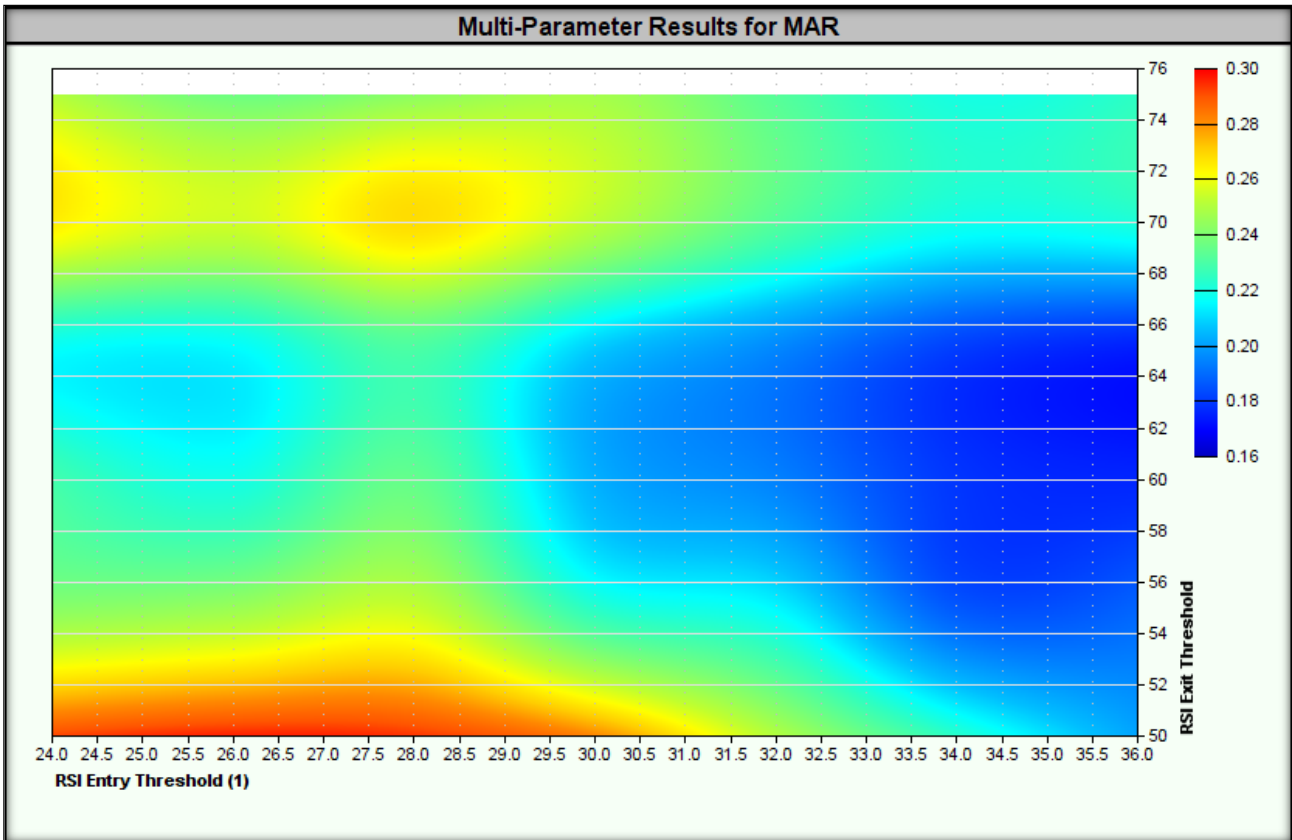


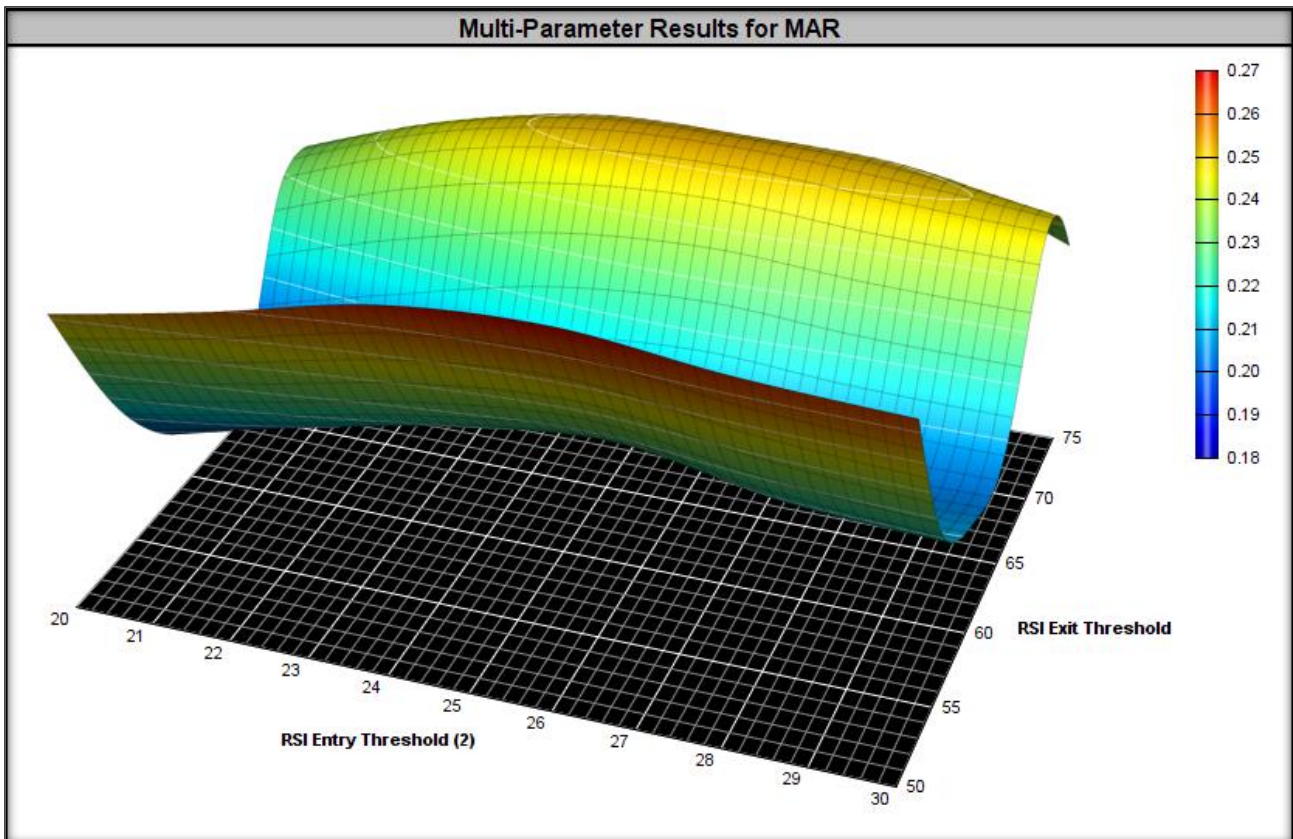
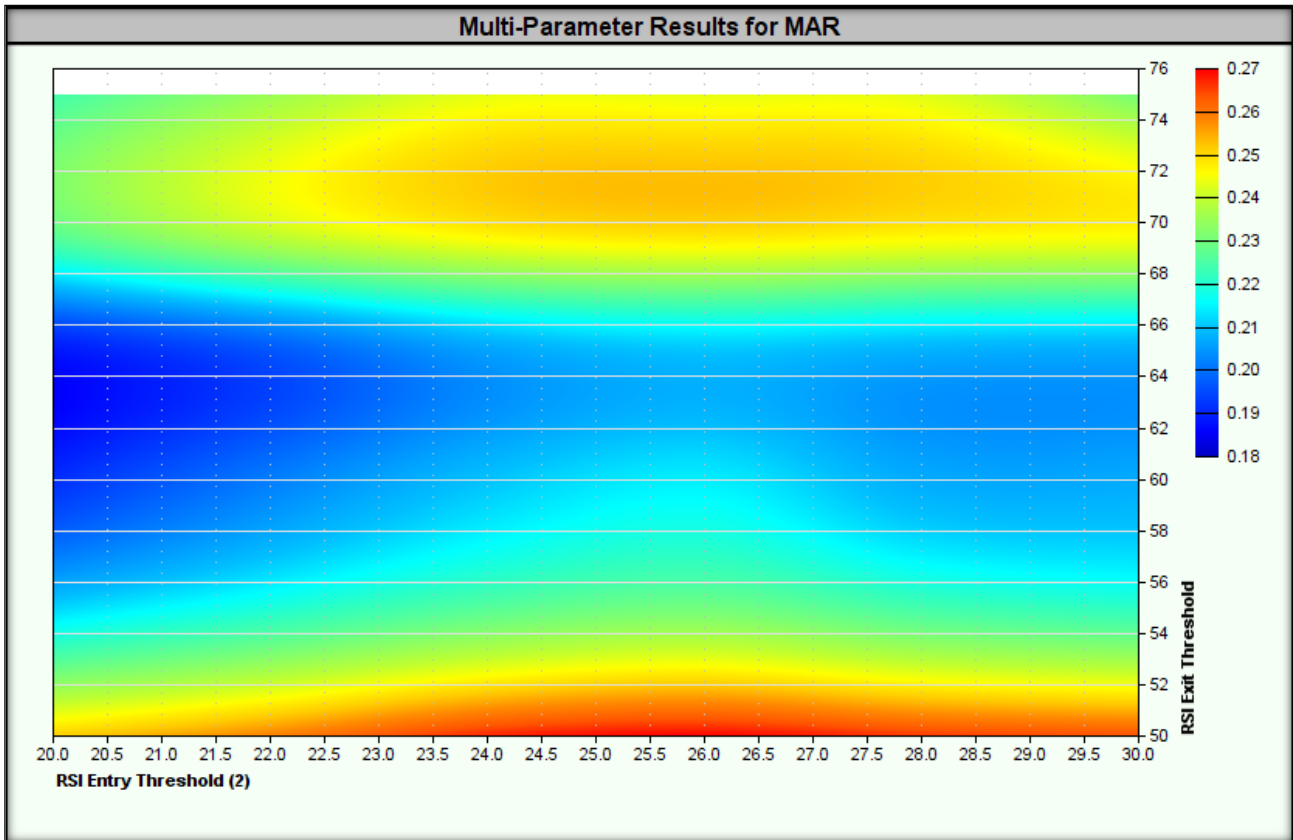


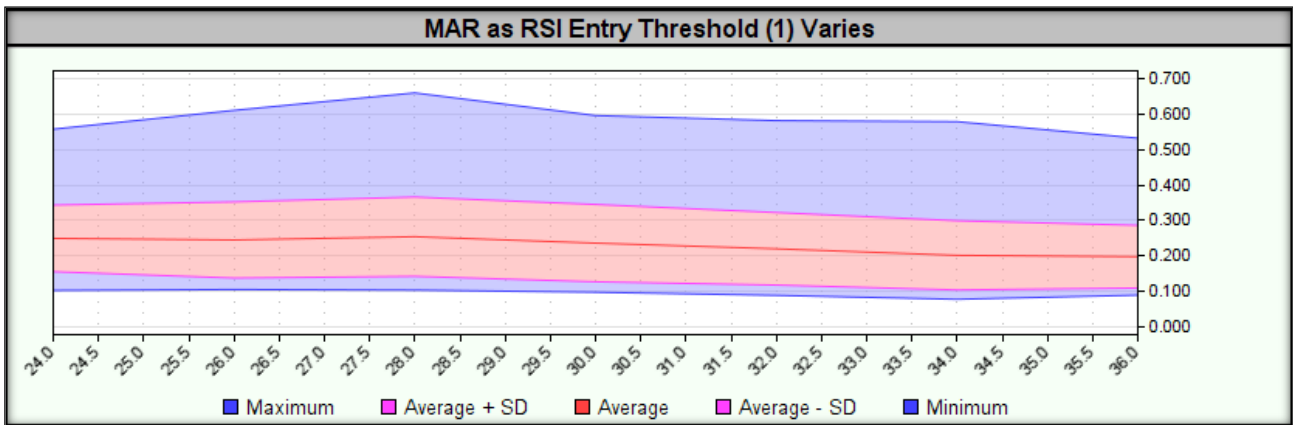
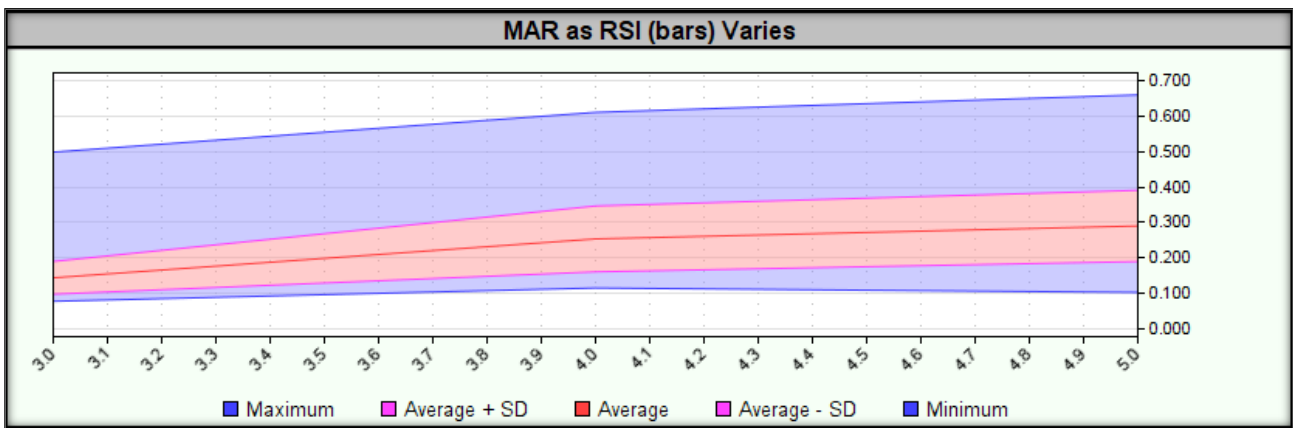
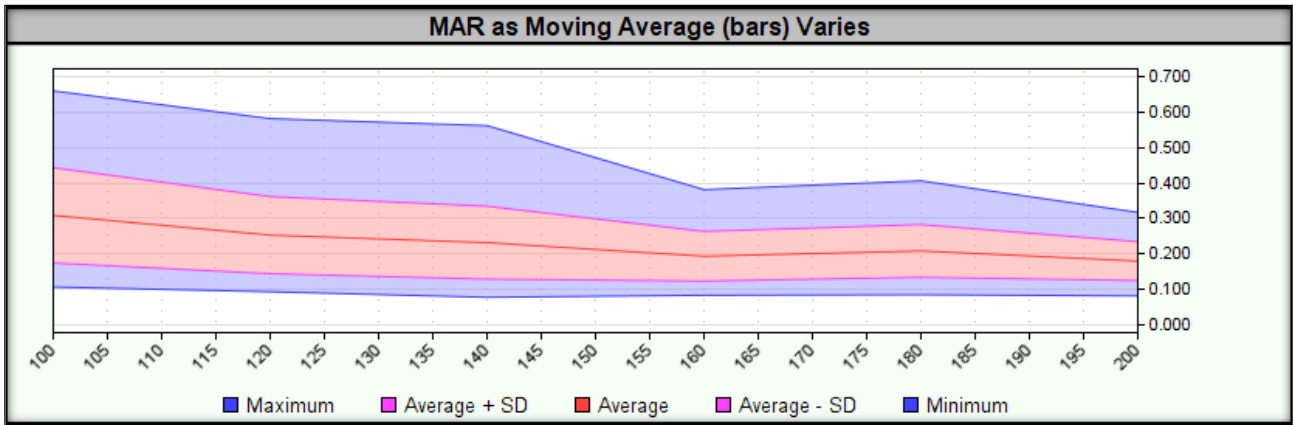


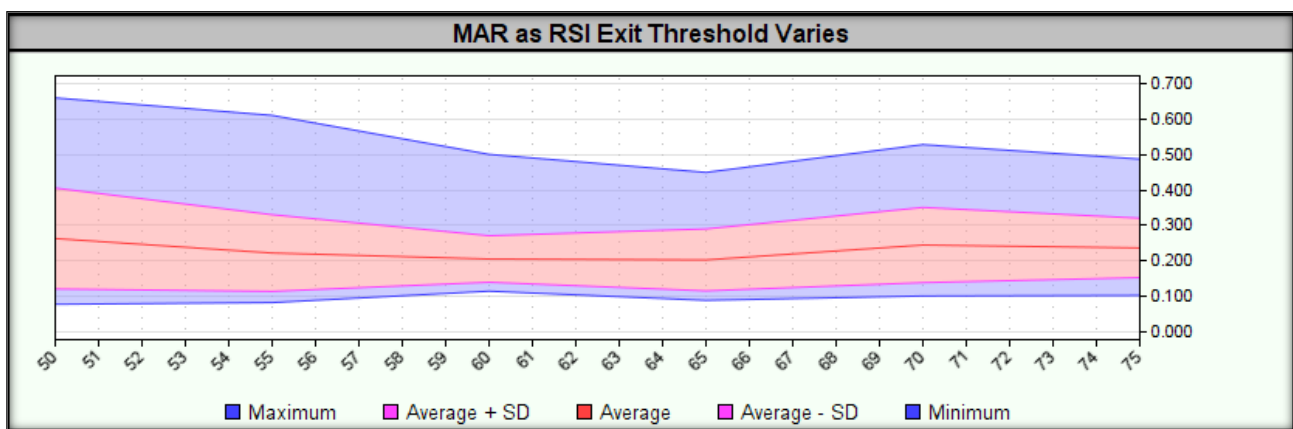
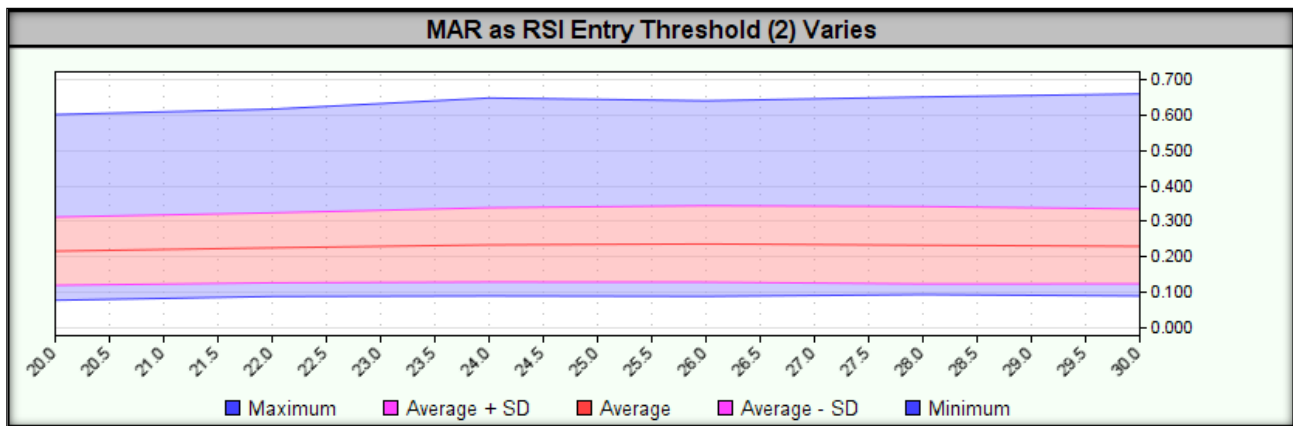












Observations for potential inclusion in further analysis or subsequent versions of the strategy, resulting from the analysis of stability test and heatmap results:

- **Sensitivity to RSI Exit Threshold** – the strategy shows high volatility depending on the RSI level used to close the position. In addition, a negative MAR is generated for RSI Exit Threshold below 50. **It is possible to move the lower range of RSI Exit to the level of 50.**
- **Moving Average (SMA) Length Optimization** – Heatmap analysis shows that strategies with shorter SMA (closer to 100 days) have higher MAR and lower drawdowns compared to longer periods. **It is possible to shorten the SMA.**
- **Adjusting RSI Entry Threshold levels** – it was noticed that it may be questionable to use two entry levels, because their optimal levels fall close to each other. **You can test pyramiding with one, lower RSI Entry Threshold level and an additional condition for opening the second unit.** However, this element is worth considering only in version v.3 of the strategy.
- **Defensive order protecting against large losses** – when analyzing the results of the strategy, it is striking that the maximum drawdown reaches 100%, which means a **potential loss of the entire capital.** A defensive mechanism for closing the position should be considered to limit the risk of large losses. However, this element is worth considering only in version v.3 of the strategy.

Based on the above conclusions, let's check the stability of the strategy on the following ranges:

- **Moving average lengths (SMA): range 60-120 days (step: 10);**
- **RSI Lengths: Range 3-5 days (step: 1);**



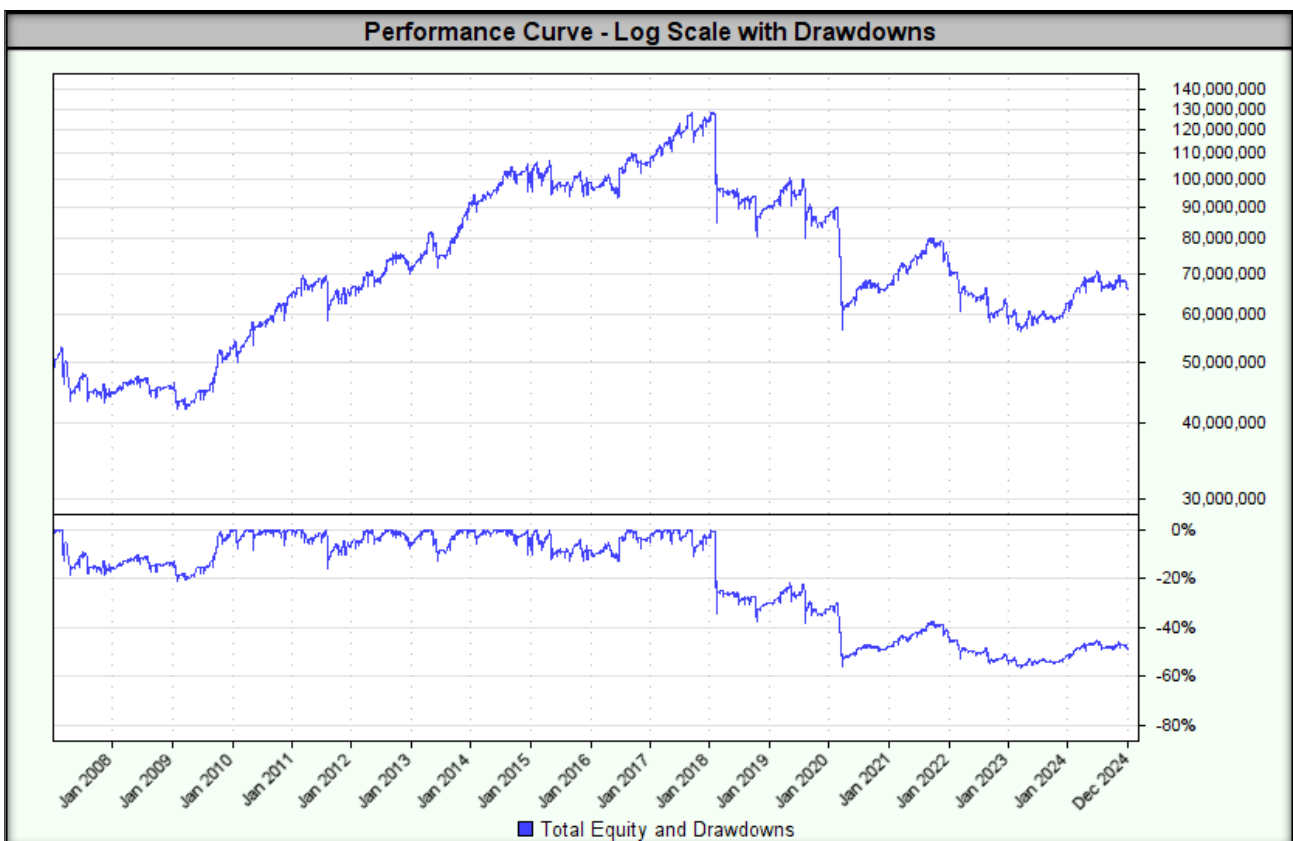
- RSI Entry Threshold (1 unit): range 24-36 (step: 2);
- RSI Entry Threshold (2 unit): range 20-30 (step: 2);
- RSI Exit Threshold (take profit): range 45-70 (step: 5).

The lowest MAR value of 0.08 was achieved for the following parameters:

- Length of the moving average (SMA): 60;
- RSI lengths: 3;
- RSI Entry Threshold (1 unit): 34;
- RSI Entry Threshold (2 units): 20;
- RSI Exit Threshold (take profit): 45.

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
181	60	3	34	20	45	\$66,098,754.97	1.56%	0.03	0.19	0.11	56.2%
175	60	3	32	30	45	\$67,022,532.88	1.64%	0.03	0.19	0.11	58.4%
211	60	3	34	30	45	\$69,444,131.19	1.84%	0.03	0.20	0.11	58.3%
169	60	3	32	28	45	\$69,519,206.52	1.85%	0.03	0.20	0.12	57.7%
145	60	3	32	20	45	\$68,844,904.60	1.78%	0.03	0.20	0.12	55.0%
4717	120	3	34	20	45	\$75,878,190.74	2.34%	0.04	0.23	0.13	65.9%
187	60	3	34	22	45	\$70,920,270.36	1.96%	0.04	0.22	0.13	54.9%
205	60	3	34	28	45	\$73,647,663.17	2.17%	0.04	0.23	0.13	57.5%
199	60	3	34	26	45	\$74,138,997.98	2.21%	0.04	0.23	0.14	56.8%
151	60	3	32	22	45	\$72,651,889.88	2.10%	0.04	0.23	0.15	53.4%
967	70	3	34	30	45	\$75,494,711.00	2.32%	0.04	0.23	0.14	58.9%

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



The highest MAR value of 0.67 was achieved for the following parameters:

- Length of the moving average (SMA): 110;

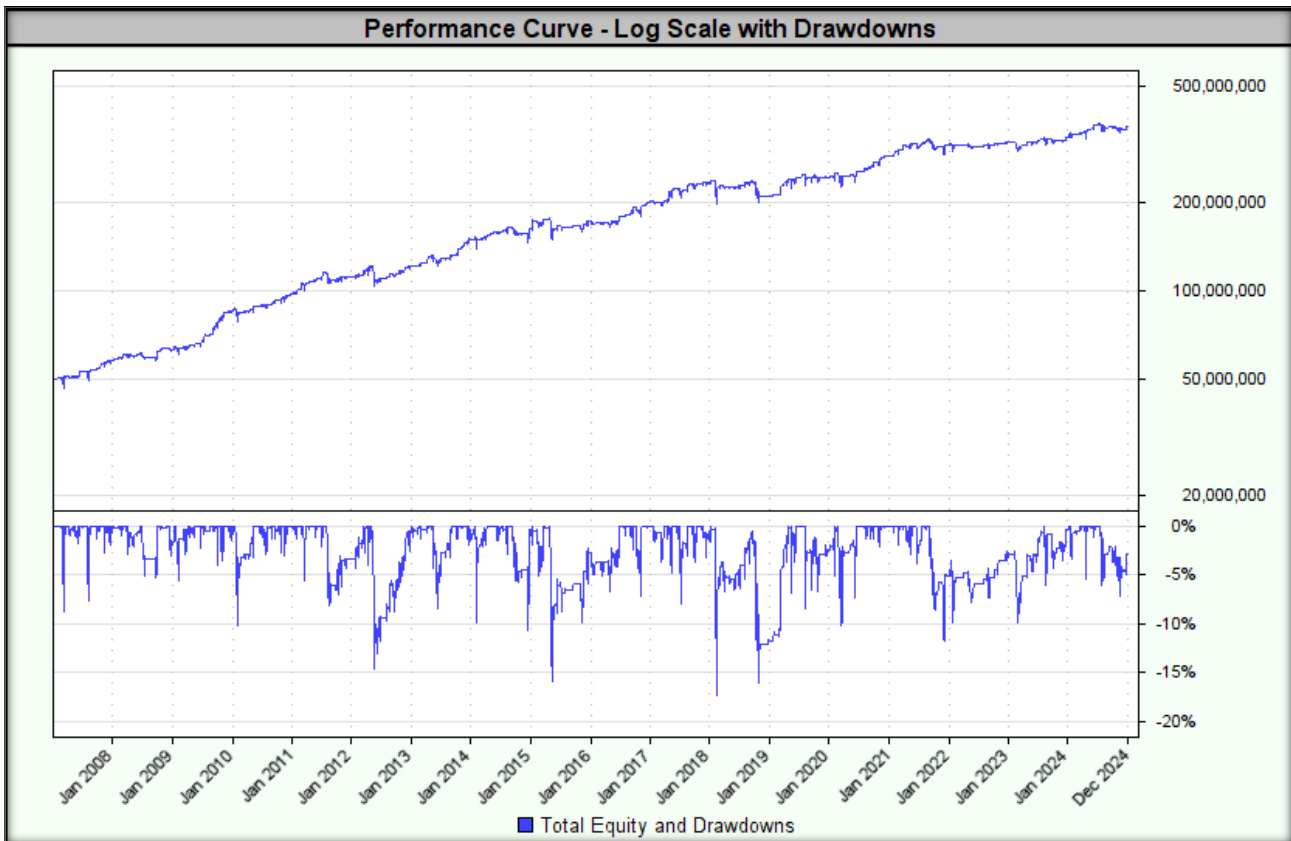


- RSI lengths: 5;
- RSI Entry Threshold (1 unit): 28;
- RSI Entry Threshold (2 units): 28;
- RSI Exit Threshold (take profit): 50.

The highest MAR value was accompanied by a drawdown of 17.3%.

Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
4382	110	5	28	28	50	\$362,260,501.89	11.63%	0.67	1.14	1.30	17.3%
3632	100	5	28	30	50	\$293,895,190.27	10.34%	0.66	1.05	1.21	15.7%
4376	110	5	28	26	50	\$350,070,470.99	11.42%	0.66	1.15	1.26	17.3%
4089	110	4	26	26	55	\$462,418,659.56	13.16%	0.65	1.09	1.28	20.1%
4083	110	4	26	24	55	\$462,193,702.84	13.15%	0.65	1.10	1.28	20.1%
3626	100	5	28	28	50	\$294,030,030.62	10.34%	0.65	1.07	1.23	15.9%
3614	100	5	28	24	50	\$268,347,107.01	9.79%	0.65	1.08	1.29	15.1%
4388	110	5	28	30	50	\$358,853,139.18	11.57%	0.64	1.12	1.28	18.1%
3620	100	5	28	26	50	\$286,089,083.77	10.18%	0.64	1.08	1.19	15.9%
4370	110	5	28	24	50	\$325,636,562.66	10.97%	0.63	1.16	1.31	17.3%
1809	80	4	26	22	55	\$343,515,131.27	11.30%	0.63	1.15	1.15	18.0%

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



For all combinations of tested parameter ranges, the highest drawdown was 94.6%!



Test	Moving Average (bars)	RSI (bars)	RSI Entry Threshold (1)	RSI Entry Threshold (2)	RSI Exit Threshold	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD
4751	120	3	34	30	65	\$277,292,219.53	9.99%	0.11	0.53	0.37	94.6%
4745	120	3	34	28	65	\$260,340,828.30	9.60%	0.10	0.52	0.37	94.6%
4739	120	3	34	26	65	\$262,207,339.04	9.64%	0.10	0.53	0.38	94.6%
4733	120	3	34	24	65	\$249,787,886.87	9.35%	0.10	0.52	0.38	94.5%
4787	120	3	36	30	65	\$271,442,266.95	9.86%	0.10	0.53	0.37	94.4%
4775	120	3	36	26	65	\$260,132,328.12	9.60%	0.10	0.53	0.38	94.4%
4781	120	3	36	28	65	\$260,941,721.05	9.61%	0.10	0.52	0.37	94.4%
4769	120	3	36	24	65	\$259,956,613.00	9.59%	0.10	0.53	0.38	94.4%
4721	120	3	34	20	65	\$227,202,463.97	8.77%	0.09	0.51	0.36	93.9%
4746	120	3	34	28	70	\$316,507,777.87	10.80%	0.12	0.54	0.41	93.8%
4727	120	3	34	22	65	\$251,550,649.99	9.39%	0.10	0.53	0.38	93.8%

In summary, the strategy failed the stability test over a wide range of optimized parameters because:

- The maximum drawdown exceeded 250% of the drawdown value for the result with the highest MAR (94.6% vs. 17.3%) – which means a high risk of deep capital drawdowns.

Therefore, **further testing of the strategy on these ranges is not justified**, because its use in real transactions is highly doubtful. Nevertheless, based on the obtained results (heatmaps for tested ranges) we can create another version of the strategy, in which we will include: i) a defensive order protecting against large losses, ii) pyramiding in another version.

2. Monte Carlo simulation

This step was skipped due to failure of previous stability tests.

3. Stability over a moving time window

This step was skipped due to failure of previous stability tests.

4. Stability long/short

This step was skipped due to failure of previous stability tests.

5. Stability in the portfolio of financial instruments

This step was skipped due to failure of previous stability tests.

6. Money Management (Position Sizing)

This step was skipped due to failure of previous stability tests.

7. Strategy Risk Management

This step was skipped due to failure of previous stability tests.



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

This step was skipped due to failure of previous stability tests.



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.