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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.

180's v.2

Investment Strategy Testing Summary

The 180's strategy is short-term **a swing trading** investment technique developed by **Jeff Cooper.** It uses **a two-day reversal pattern** within an ongoing trend, with the goal of identifying when **a short-term pullback presents an opportunity to open a long position.** This is **an approach that follows the prevailing trend but uses short-term corrections** to enter a position at a more favorable price.

Compared to version 180's v.1 of this strategy, the parameters have been **optimized** using **The Grid technique Search,** as well as the range of financial instruments has been expanded. Although **the strategy results on in-sample data are decent,** the strategy did not pass the stability test on the portfolio of financial instruments. This means that the strategy loses its profitability when tests are carried out on a suboptimal set of instruments. 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.

Contents

Step 1: Formulate an investment strategy

180's is **a short-term investment strategy** developed by **Jeff Cooper** that is based on the analysis of **one-day trend reversals and continuation of the move** in the direction of the original trend.

The strategy uses **a two-day reversal pattern** within an ongoing trend, and its goal is to identify when **a short-term pullback presents an opportunity to open a long position.** It is **an approach that follows the prevailing trend but uses short-term corrections** to enter a position at a more favorable price.

Strategy assumptions:

- The strategy identifies **short-term reversals** after which **the trend should resume;**
- Positions are opened **only in the direction of the trend** – the strategy focuses on **long positions;**
- Key entry conditions are based on **candle closes relative to the daily range** (candlestick formation).

The strategy involves **entering a long position** when **a candlestick formation is formed,** taking advantage of a potential **price rebound.**

Characteristics of the strategy and its strengths and weaknesses:

- **Simple signal identification** – based on price analysis and moving averages, without the need to use additional indicators;
- **Using market momentum** – positions are opened based on strong price movements, which increases the probability of a successful trade;
- **Clear risk management rules –** using stop loss orders allows you to limit losses in the event of a signal failure;
- **False signals in case of a dynamic trend change** – during periods of a rapid trend change the strategy may generate losing signals.

To test the above strategy, we will make the following **changes and extensions:**

- **Instead of stocks and ETFs,** tests were performed on **a wide range of futures contracts;**
- **Stop loss** was set below the price low of the candlestick formation;
- **The position** is closed after **the stop loss order is activated.** or when the price falls below a longer moving average.

Jeff Cooper's 180's strategy is a **one-day reversal and trend continuation** approach. It uses **simple but effective price rules** and by filtering positions with **moving averages,** it avoids false signals.

Its main advantages are **ease of implementation, clear rules and compliance with market momentum, but appropriate risk management** remains crucial.

Step 2: Define investment principles

Below is **the pseudocode** for the **180's strategy** on daily data:

1. **Candlestick pattern (candle formation):**
   a. **On the first day,** the closing price must be within **the lower XX% of the daily range and below the opening price.**
   b. **On the second day,** the closing price must be within **the upper XX% of the daily range and above the opening price.**
2. **Trend Confirmation:** The second day's closing price must be above both the YY-day and ZZ-day moving averages, confirming an uptrend.
3. **Entry into position:** On the third day, a position is opened one tick above the high of the candlestick formation.
4. **Conditions for closing a position:**
   a. **Loss Order:** Initial stop loss is set at 1 tick below the price low of the candlestick formation.
   b. **Trailing stop:** Price falls below the ZZ daily moving average.
5. **Daily monitoring:**
   a. The conditions for opening positions and executing orders are checked every day.
   b. The system checks whether the entry conditions are met and whether the stop loss should be moved.
6. **Additional notes:**
   a. **No Short Positions:** The strategy focuses only on long positions in an uptrend.
   b. **Financial Instruments: A wide range of futures contracts** were used for the purposes of this test.

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 **0.5% of the total capital,** with **a stop loss order** set below **the price low of the candlestick formation.**

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 Nasdaq 100 futures contract.** In early October 2024, **the contract fell** and **the closing price was in the lower 25% of the daily range** (first candle in the rectangle on the left). Additionally, **the closing price of this candle was lower than the opening price,** confirming short-term downward pressure. The next day, **the closing price was in the upper 25% of the daily range** and **exceeded the opening price** (second candle in the rectangle on the left). In addition, the closing price of this candle fell above the **10-day and 50-day moving averages. The position was opened the next day** when the price rose **above the high of both candles** (third candle in the rectangle on the left). **The stop loss was set at the low of both candles (red dot),** which limited the risk of loss in the event of a signal failure.

In mid-December 2024, **after several dozen days of growth, the price of the futures contract fell sharply. High market volatility** in the following days led to the activation of the **Trailing Stop order,** which was set at the level of **the 50-day moving average. The position was closed** (candle in the rectangle on the right). **The system worked correctly.**

The second transaction was made on a **gold futures contract.** At the end of August 2024, **the contract fell** and **the closing price was in the lower 25% of the daily range** (first candle in the rectangle on the left). Additionally, **the closing price of this candle was lower than the opening price,** confirming short-term downward pressure. The next day, **the closing price was in the upper 25% of the daily range** and **exceeded the opening price** (second candle in the rectangle on the left). Furthermore, the closing price of this candle fell **above the 10 -day and 50-day moving averages. The position was opened the next day** when the price rose **above the high of both candles** (third candle in the rectangle on the left). **The stop loss was set at the low of both candles (red dot),** which limited the risk of loss in the event of a signal failure.

After a few days, gold prices **fell, activating the original stop loss order. The position was closed** (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, Jeff Cooper.**

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:

- **Short Moving Average (SMA) Length:** 10 days;
- **Long Moving Average (SMA) Lengths:** 100 days;
- **Formation candle:**
  - The closing price of the first candle is in **the lower 20% of the daily range and below the opening price;**
  - The closing price of the second candle is in **the upper 20% of the daily range and above the opening price;**
  - The closing price of the second candle is **above both the 10-day and 100-day moving averages;**
- **Stop loss:** 1 tick below the price low of the candlestick formation;

- **Method of opening a position:** one tick above the high of the candlestick formation;
- **Position size:** corresponding to a risk of 0.5% of total capital;
- **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.

Performance Curve - Log Scale with Drawdowns
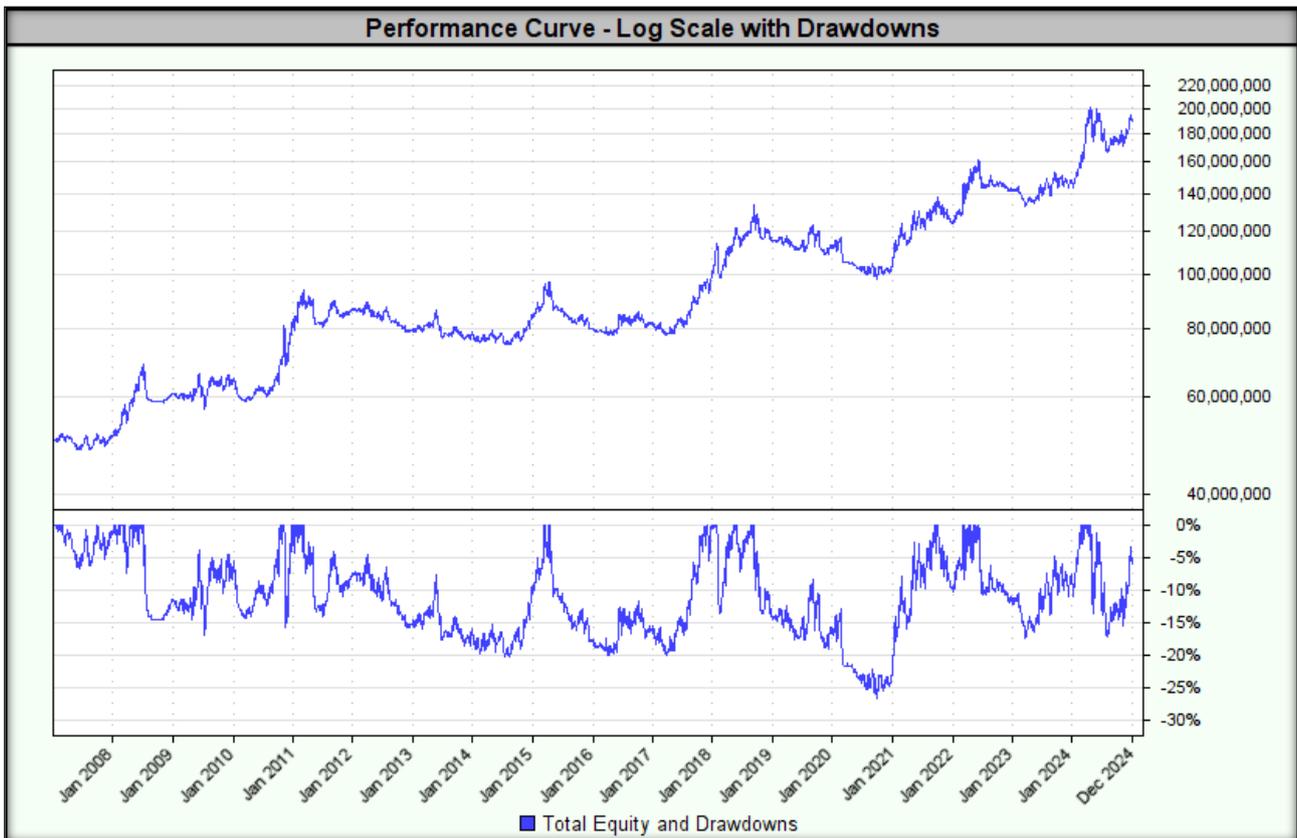
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

Indicators/Measures	Concluding a transaction at the opening price
CAGR%	7.7%
MAR Ratio	0.29
RAR%	6.1%
R-Cubed	0.17
Robust Sharpe Ratio	0.47
Max Drawdown	26.8%
Wins	22.5%
Losses	77.5%
Average Win%	2.60%
Average Loss %	0.44%
Win/ Loss Ratio	5.94
Average Trade Duration (days)	44
Percent Profit Factor	1.72

SQN	0.61
Number of transactions	659

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

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**

Strategy 180's v.2 in this version it assumes **optimization of parameters proposed by the creator of the strategy - Jeff Cooper.** 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:

*   **Short Moving Average (SMA) Lengths:** Range **5-15 days (step: 1);**
*   **Long Moving Average (SMA) Lengths: 100-150 day** range **(step: 5);**
*   **Lower closing range of the first candle and upper closing range of the second candle:** range **15%-25% (step: 1 pp.).**

The purpose of this test is to check whether **the strategy remains stable (robust)** over a wide range of parameters, which will allow to assess its usefulness in real market conditions. **The key evaluation criterion is that all test results show a positive MAR value, and the maximum drawdown does 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 completely rejected.

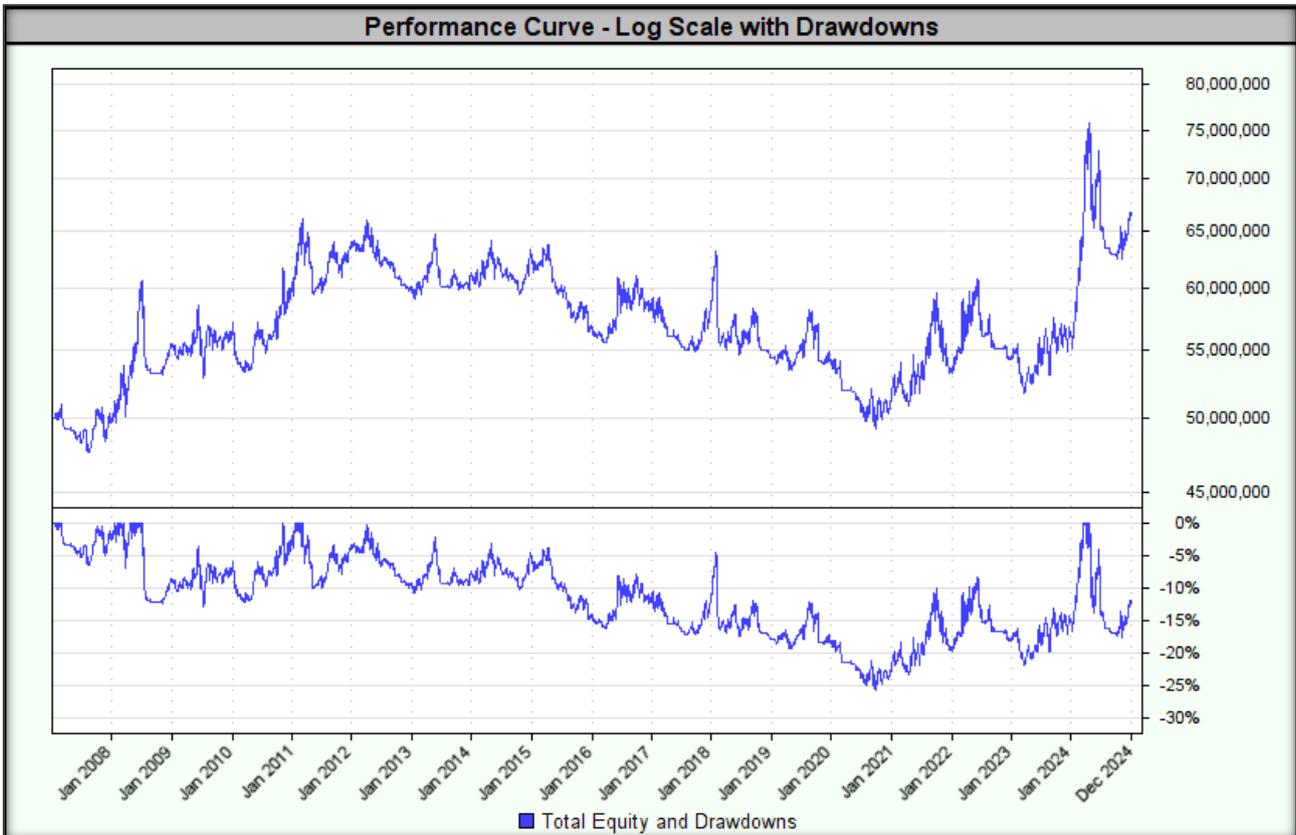**The lowest MAR value of 0.06** was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 11;
- **Long Moving Average (SMA) Lengths:** 105;
- **Lower closing range of the first candle and upper closing range of the second candle:** 15%.

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

Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
738	11	105	15%	$66,401,878.86	1.59%	0.06	0.22	0.25	25.7%	156.3	396
1101	14	105	15%	$69,932,103.89	1.88%	0.07	0.25	0.28	26.5%	155.7	398
739	11	105	16%	$74,203,822.14	2.22%	0.07	0.27	0.29	30.3%	156.4	454
1222	15	105	15%	$70,408,700.70	1.92%	0.07	0.26	0.28	25.6%	155.6	398
805	11	135	16%	$74,682,276.89	2.25%	0.08	0.27	0.31	29.0%	187.9	433
133	6	105	15%	$75,111,994.16	2.29%	0.08	0.29	0.30	29.1%	155.7	425
838	11	150	16%	$82,976,687.22	2.85%	0.08	0.32	0.30	35.8%	164.0	422
859	12	105	15%	$70,999,104.57	1.97%	0.08	0.26	0.29	24.5%	155.6	398
749	11	110	15%	$71,126,335.32	1.98%	0.08	0.26	0.33	24.5%	155.2	388
980	13	105	15%	$71,781,940.82	2.03%	0.08	0.27	0.30	24.7%	155.6	394
122	6	100	15%	$71,160,683.03	1.98%	0.08	0.26	0.30	24.0%	155.9	429

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.

Performance Curve - Log Scale with Drawdowns

The highest MAR value of 0.63 was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 5;
- **Long Moving Average (SMA) Lengths:** 100;
- **Lower closing range of the first candle and upper closing range of the second candle:** 24%.
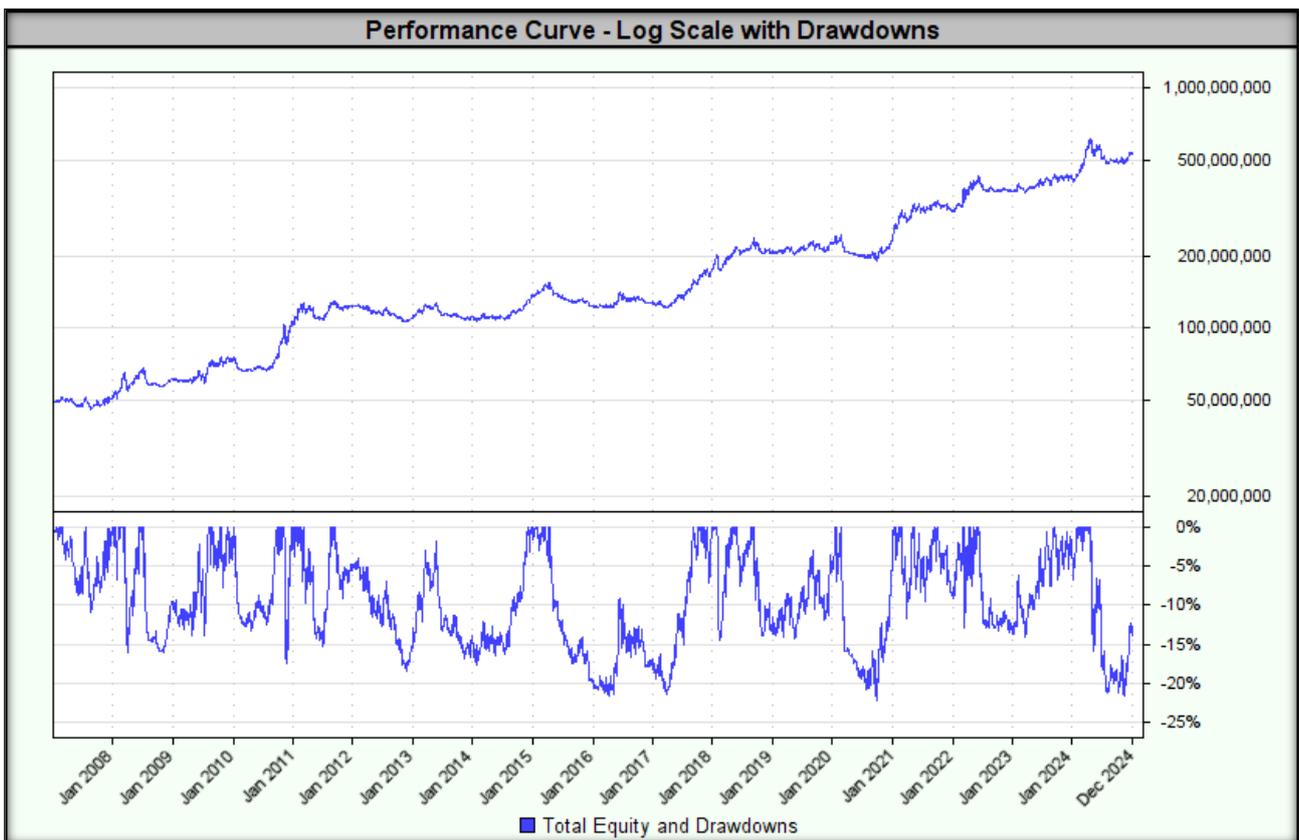
The highest MAR value was accompanied by **a drawdown of 22.3%.**

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

Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR ▽	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
10	5	100	24%	$537,410,648.61	14.10%	0.63	0.87	1.00	22.3%	38.5	853
9	5	100	23%	$510,336,367.51	13.78%	0.63	0.91	1.06	21.9%	38.5	809
218	6	140	23%	$538,017,033.45	14.11%	0.61	0.89	0.89	23.3%	44.3	702
64	5	125	23%	$593,664,833.44	14.74%	0.60	0.91	1.15	24.5%	44.6	758
32	5	110	24%	$563,627,379.83	14.41%	0.59	0.86	0.99	24.4%	45.4	825
97	5	140	23%	$539,886,836.43	14.13%	0.59	0.88	0.92	24.1%	44.7	724
31	5	110	23%	$537,689,378.12	14.11%	0.59	0.89	1.06	24.1%	39.1	783
53	5	120	23%	$562,894,353.82	14.40%	0.58	0.90	1.07	24.8%	45.6	762
220	6	140	25%	$642,629,129.80	15.24%	0.58	0.89	0.84	26.2%	44.6	767
242	6	150	25%	$653,130,696.49	15.35%	0.58	0.88	0.79	26.4%	44.8	769
11	5	100	25%	$509,793,985.46	13.77%	0.58	0.85	0.93	23.7%	39.2	902

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.

Performance Curve - Log Scale with Drawdowns

For all combinations of tested parameter ranges, **the highest drawdown was 36.3%.**

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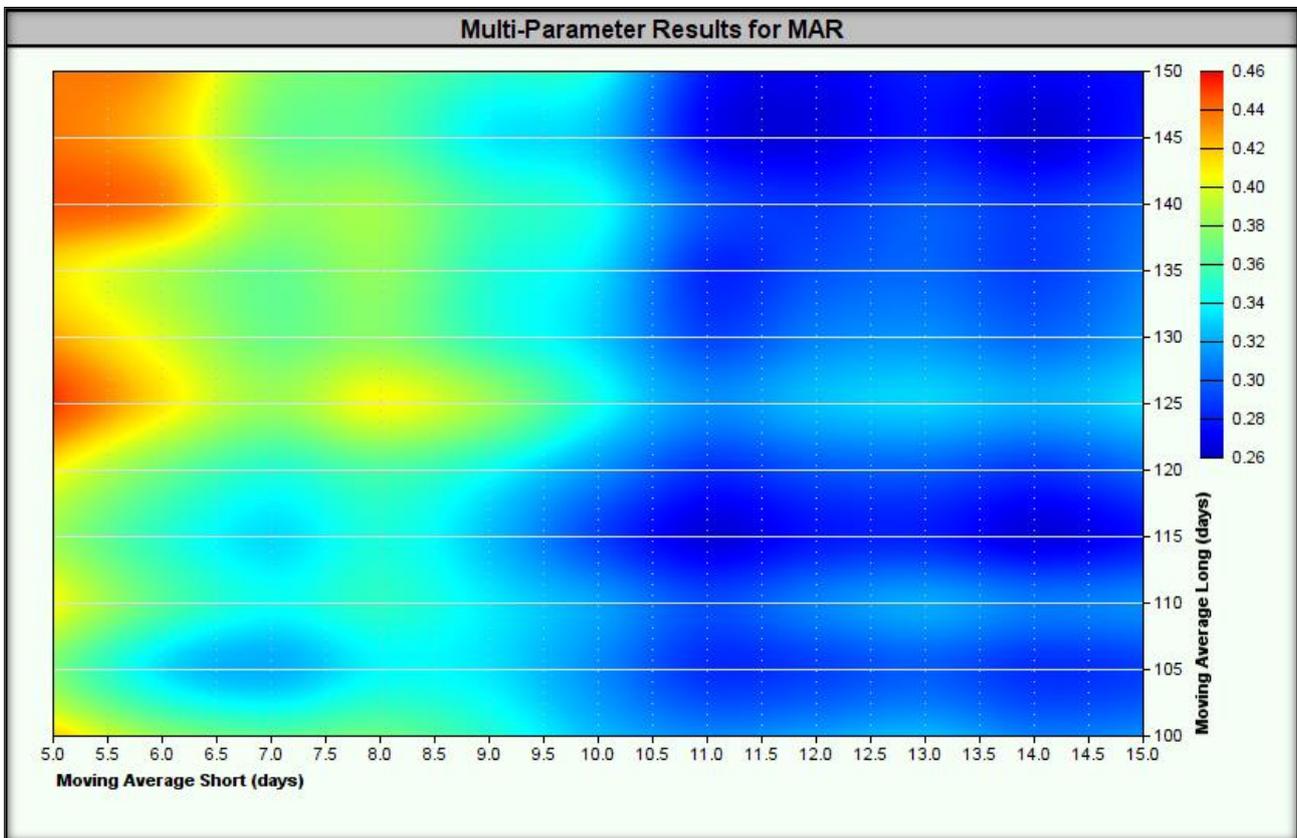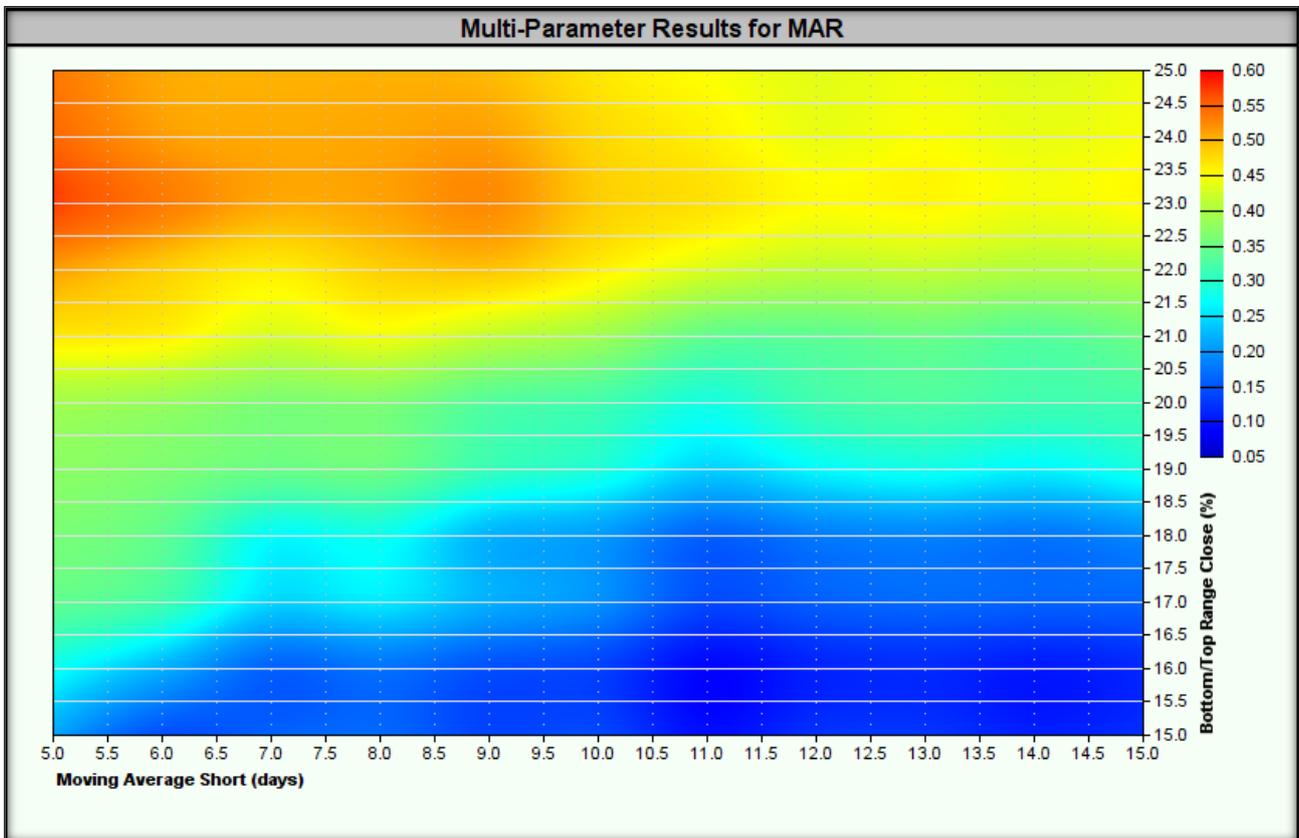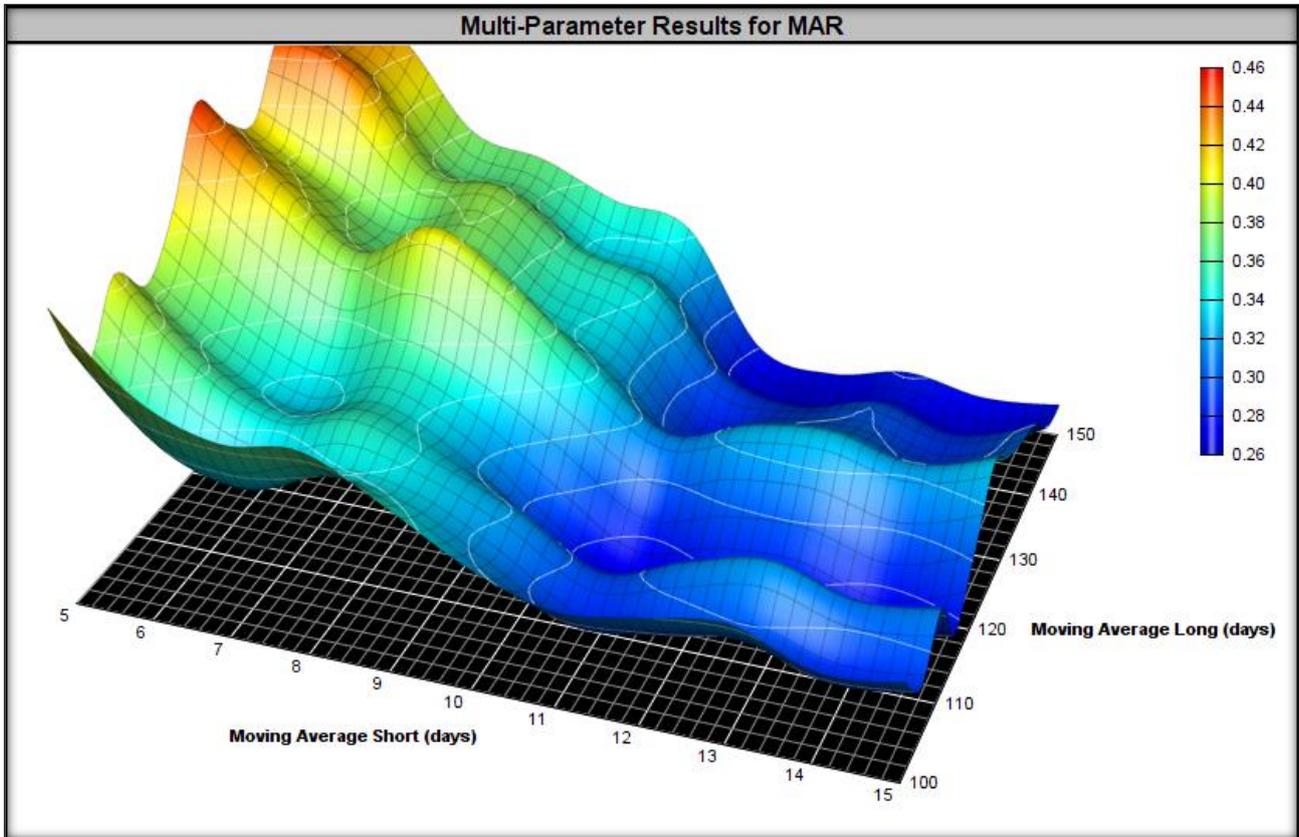
Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD ▽	Longest DD	Trades
1201	14	150	16%	$89,282,308.65	3.27%	0.09	0.35	0.34	36.3%	164.0	420
959	12	150	16%	$88,989,828.01	3.25%	0.09	0.35	0.33	35.9%	164.0	418
838	11	150	16%	$82,976,687.22	2.85%	0.08	0.32	0.30	35.8%	164.0	422
1322	15	150	16%	$91,236,674.71	3.40%	0.10	0.37	0.35	35.0%	163.1	416
1080	13	150	16%	$90,535,676.70	3.35%	0.10	0.36	0.34	34.7%	164.0	418
827	11	145	16%	$86,790,368.57	3.11%	0.09	0.34	0.33	34.0%	163.9	421
1190	14	145	16%	$95,041,912.03	3.63%	0.11	0.39	0.38	33.6%	163.0	419
948	12	145	16%	$94,433,488.56	3.60%	0.11	0.39	0.37	33.1%	163.1	417
957	12	145	25%	$416,241,439.38	12.50%	0.38	0.78	0.72	32.9%	44.8	743
1320	15	145	25%	$415,044,645.34	12.48%	0.38	0.77	0.73	32.5%	44.8	733
1199	14	145	25%	$398,301,863.68	12.22%	0.38	0.76	0.70	32.5%	46.0	742

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 **(36.3% vs. 22.3%)** – which means an acceptable risk of deep capital drawdowns.

Heatmaps for the tested ranges are presented below.

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

MAR as Moving Average Short (days) Varies

■ Maximum ■ Average + SD ■ Average ■ Average - SD ■ Minimum

MAR as Moving Average Long (days) Varies

MAR as Bottom/Top Range Close (%) Varies
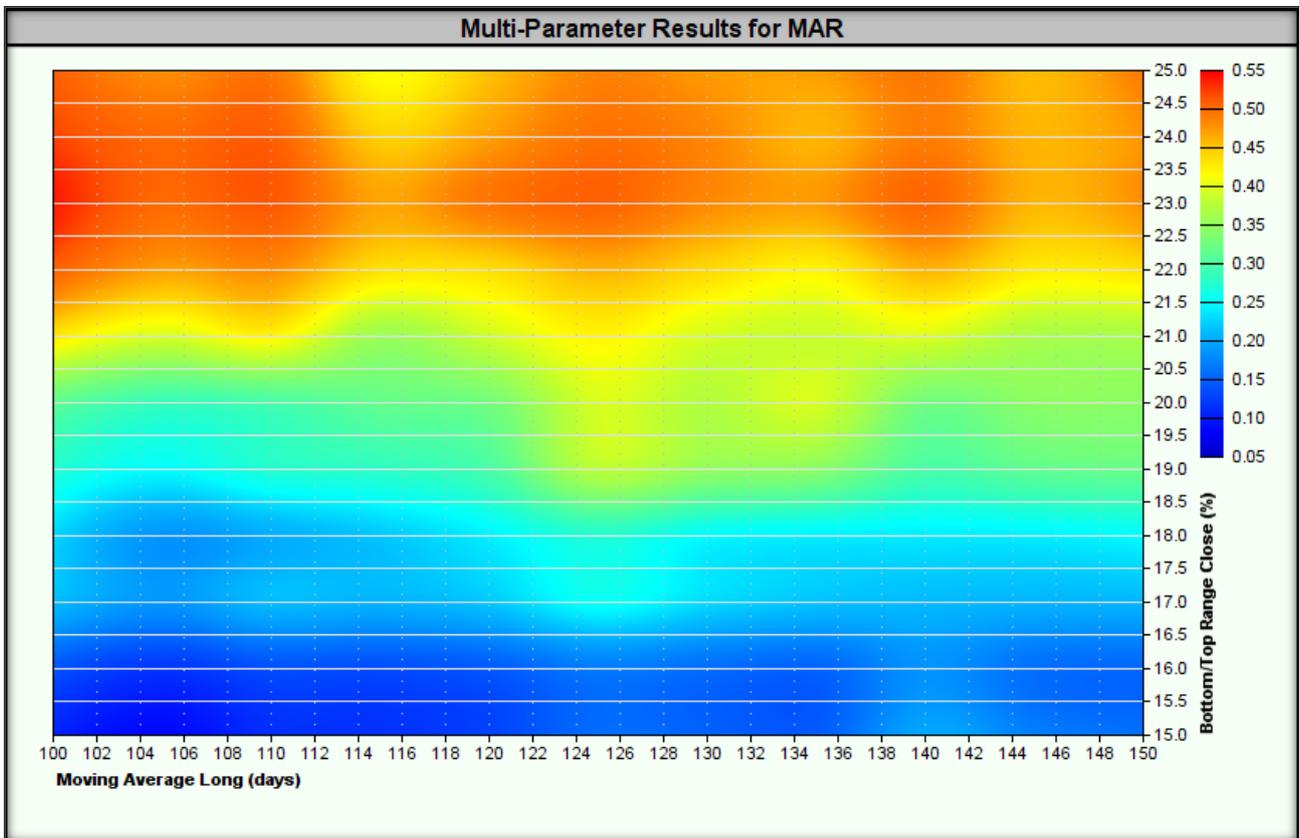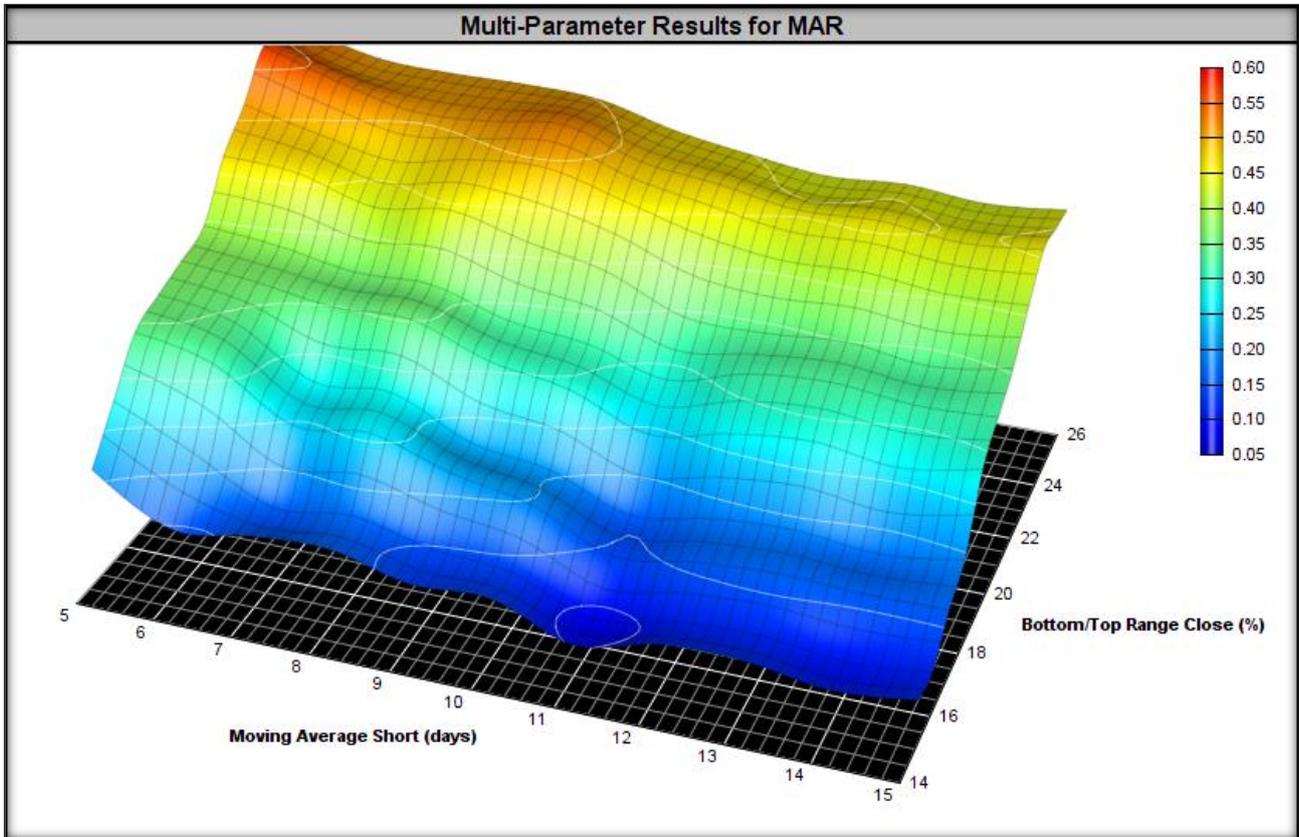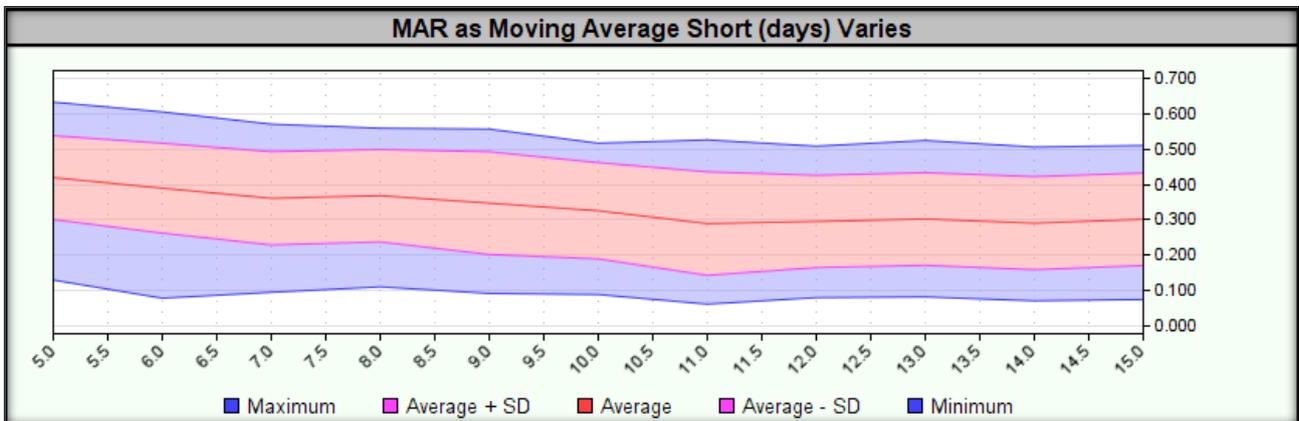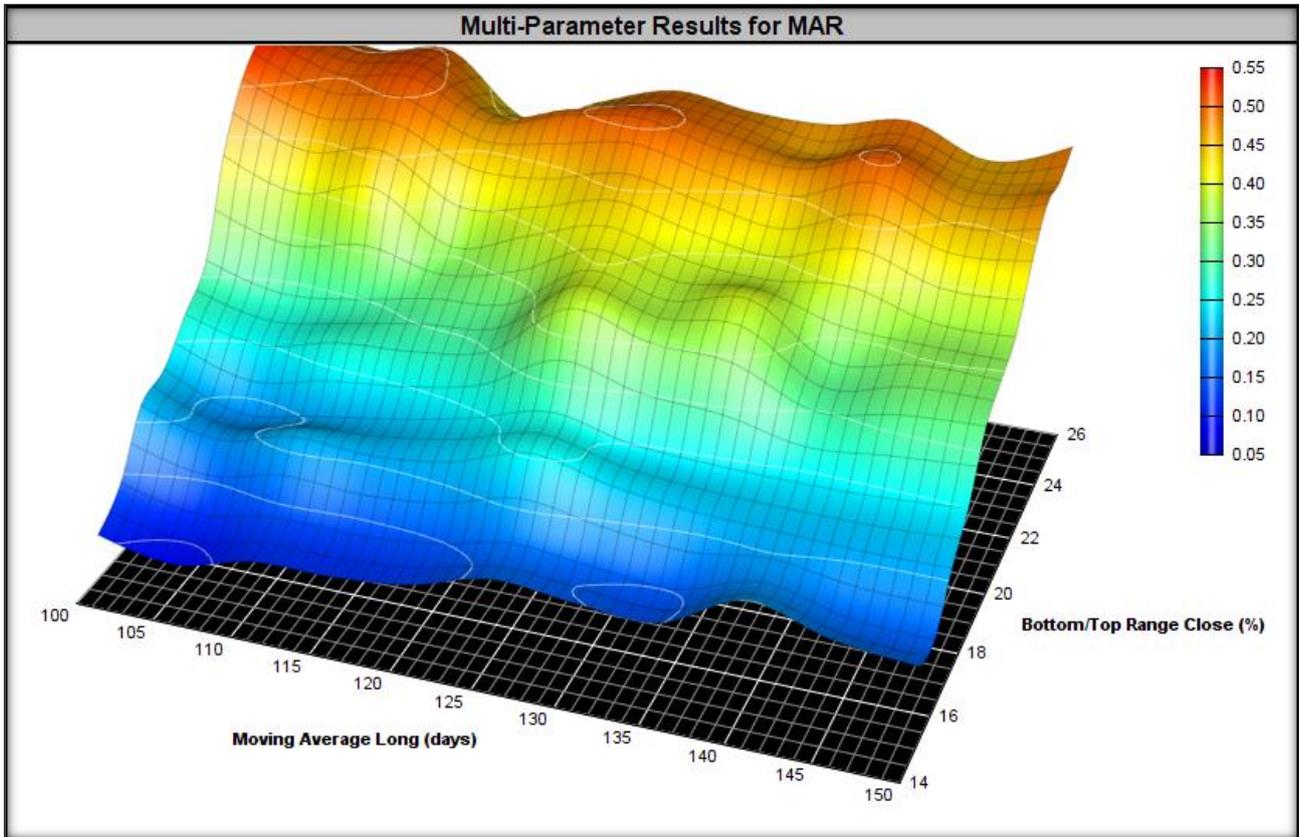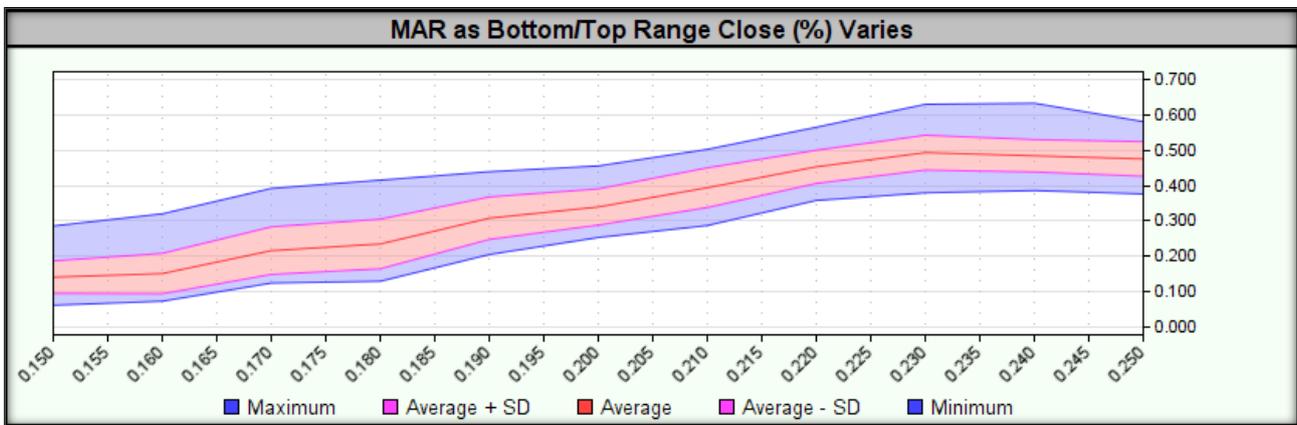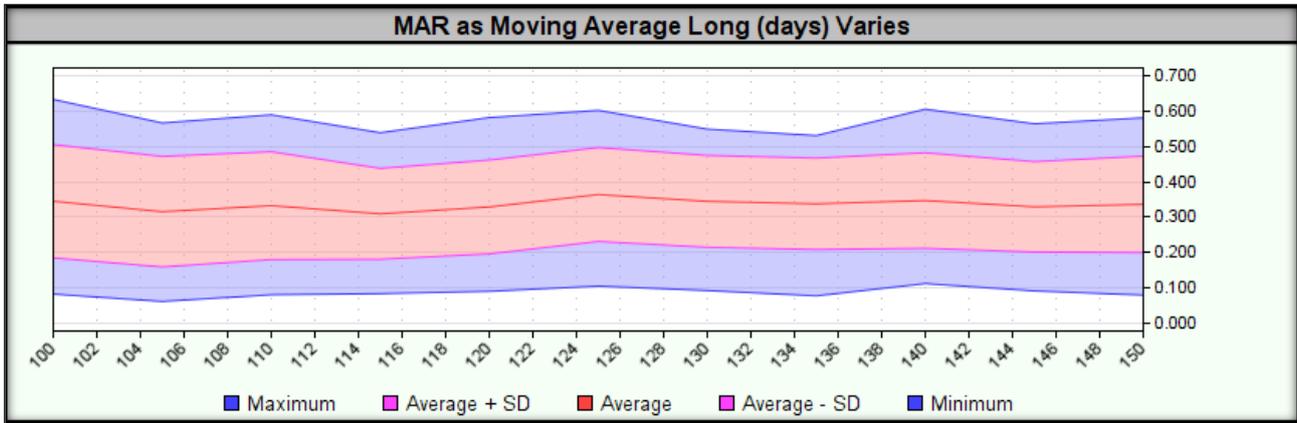
After passing the stability tests on **the in-sample data,** it is time perform the same on **the out-of-sample data.** For this purpose, we use **the same range of parameters** as on the in-sample data:

- **Short Moving Average (SMA) Lengths:** Range **5-15 days (step: 1);**
- **Long Moving Average (SMA) Lengths: 100-150 day** range **(step: 5);**
- **Lower closing range of the first candle and upper closing range of the second candle:** range **15%-25% (step: 1 pp.).**

The lowest MAR value of 0.04 was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 5;
- **Long Moving Average (SMA) Lengths:** 100;
- **Lower closing range of the first candle and upper closing range of the second candle:** 16%.

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

Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
2	5	100	16%	$57,187,154.82	1.50%	0.04	0.18	0.15	34.0%	81.7	272
244	7	100	16%	$58,178,741.69	1.70%	0.05	0.19	0.15	35.8%	75.6	262
123	6	100	16%	$58,616,122.51	1.78%	0.05	0.19	0.16	33.0%	75.6	267
13	5	105	16%	$59,682,912.61	1.99%	0.06	0.21	0.18	35.7%	81.7	270
255	7	105	16%	$60,487,722.38	2.14%	0.06	0.22	0.18	35.7%	74.5	260
970	13	100	16%	$59,799,280.28	2.01%	0.06	0.22	0.18	31.8%	75.6	257
849	12	100	16%	$59,961,943.70	2.04%	0.06	0.22	0.18	31.8%	75.6	255
1091	14	100	16%	$59,966,018.38	2.04%	0.06	0.23	0.18	31.5%	75.6	259
266	7	110	16%	$62,262,995.99	2.47%	0.07	0.24	0.19	37.8%	74.5	254
969	13	100	15%	$60,878,516.99	2.21%	0.07	0.24	0.21	33.3%	75.6	229
24	5	110	16%	$61,818,146.99	2.39%	0.07	0.23	0.20	35.4%	74.5	263
848	12	100	15%	$61,045,576.94	2.24%	0.07	0.24	0.22	33.2%	75.6	227

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 0.57 was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 10;
- **Long Moving Average (SMA) Lengths:** 115;
- **Lower closing range of the first candle and upper closing range of the second candle:** 23%.

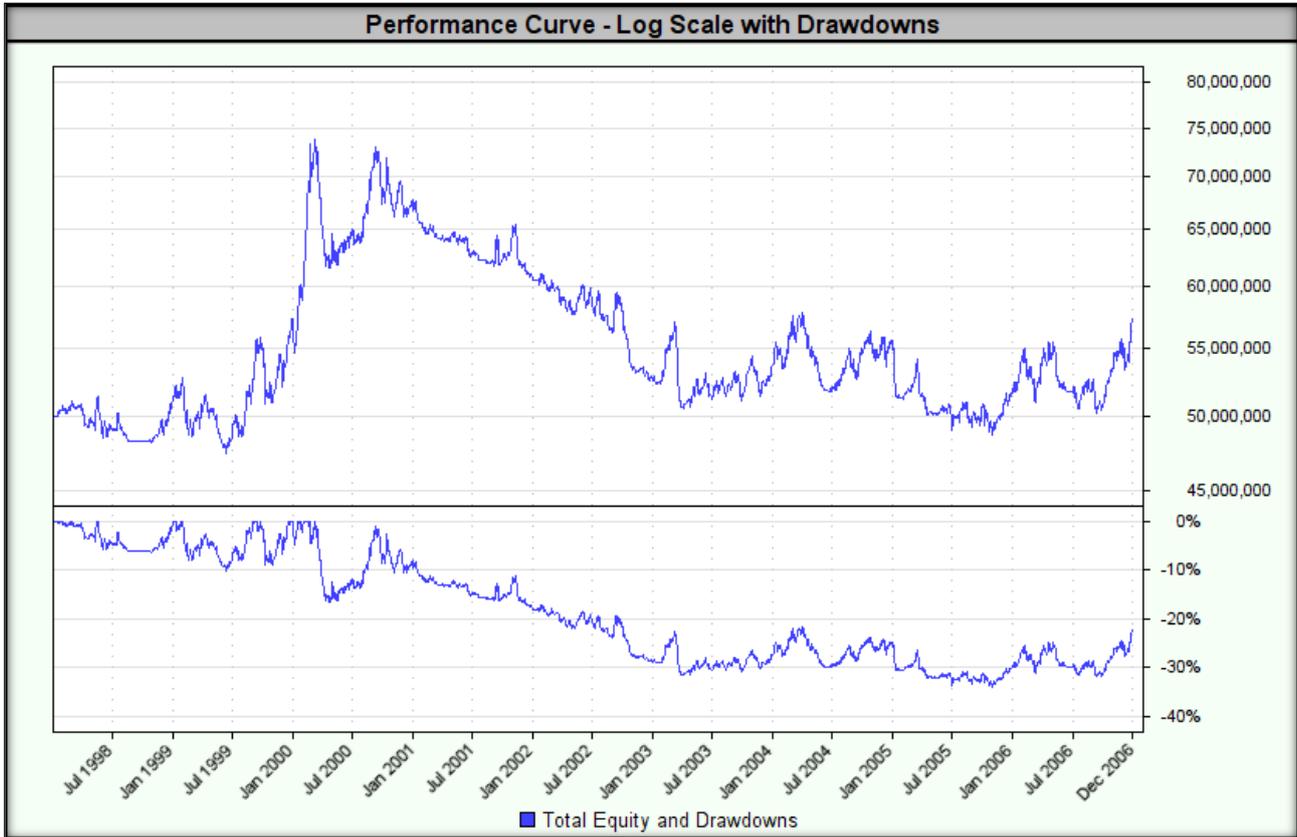**The highest MAR value** was accompanied by **a drawdown of 23.5%.**

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

Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR ▽	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades ⌃
647	10	115	23%	$155,550,743.36	13.45%	0.57	0.79	0.69	23.5%	35.9	343
768	11	115	23%	$160,142,015.87	13.82%	0.57	0.81	0.71	24.3%	36.3	342
767	11	115	22%	$159,290,168.83	13.75%	0.56	0.81	0.72	24.4%	35.9	328
646	10	115	22%	$154,197,083.06	13.34%	0.56	0.78	0.70	23.7%	35.9	330
779	11	120	23%	$155,554,899.63	13.45%	0.55	0.79	0.71	24.4%	36.3	343
778	11	120	22%	$154,992,208.52	13.41%	0.55	0.78	0.73	24.4%	36.3	329
658	10	120	23%	$150,824,398.11	13.07%	0.55	0.77	0.69	23.8%	35.9	344
657	10	120	22%	$149,969,638.94	12.99%	0.55	0.76	0.71	23.8%	35.9	331
526	9	115	23%	$154,475,236.48	13.37%	0.55	0.78	0.68	24.5%	36.3	343
525	9	115	22%	$152,506,826.56	13.21%	0.54	0.77	0.69	24.6%	36.3	331
537	9	120	23%	$150,111,324.79	13.01%	0.53	0.76	0.68	24.4%	37.2	344
405	8	115	23%	$153,660,185.22	13.30%	0.53	0.77	0.67	25.1%	37.2	346

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.

Performance Curve - Log Scale with Drawdowns
Total Equity and Drawdowns
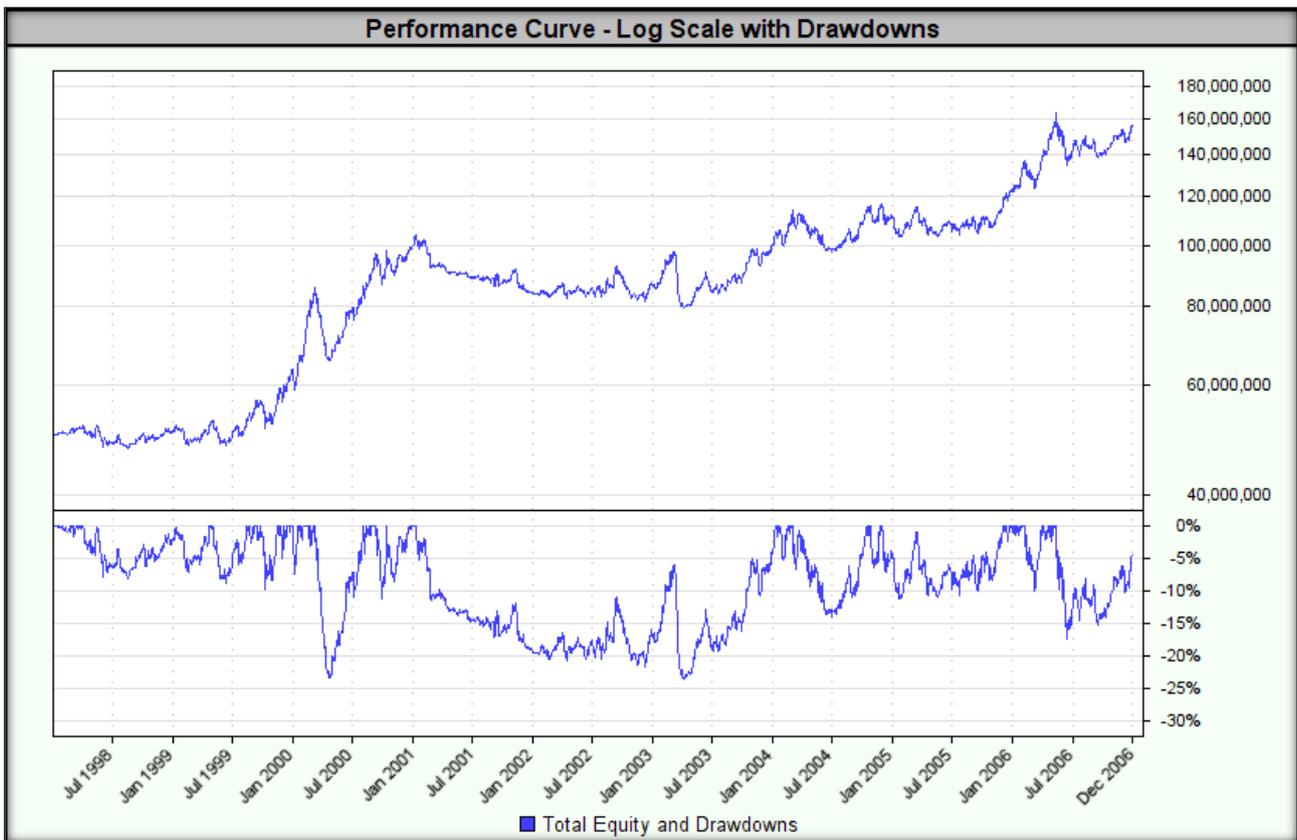
For all combinations of tested parameter ranges, **the highest drawdown was 41.9%.**
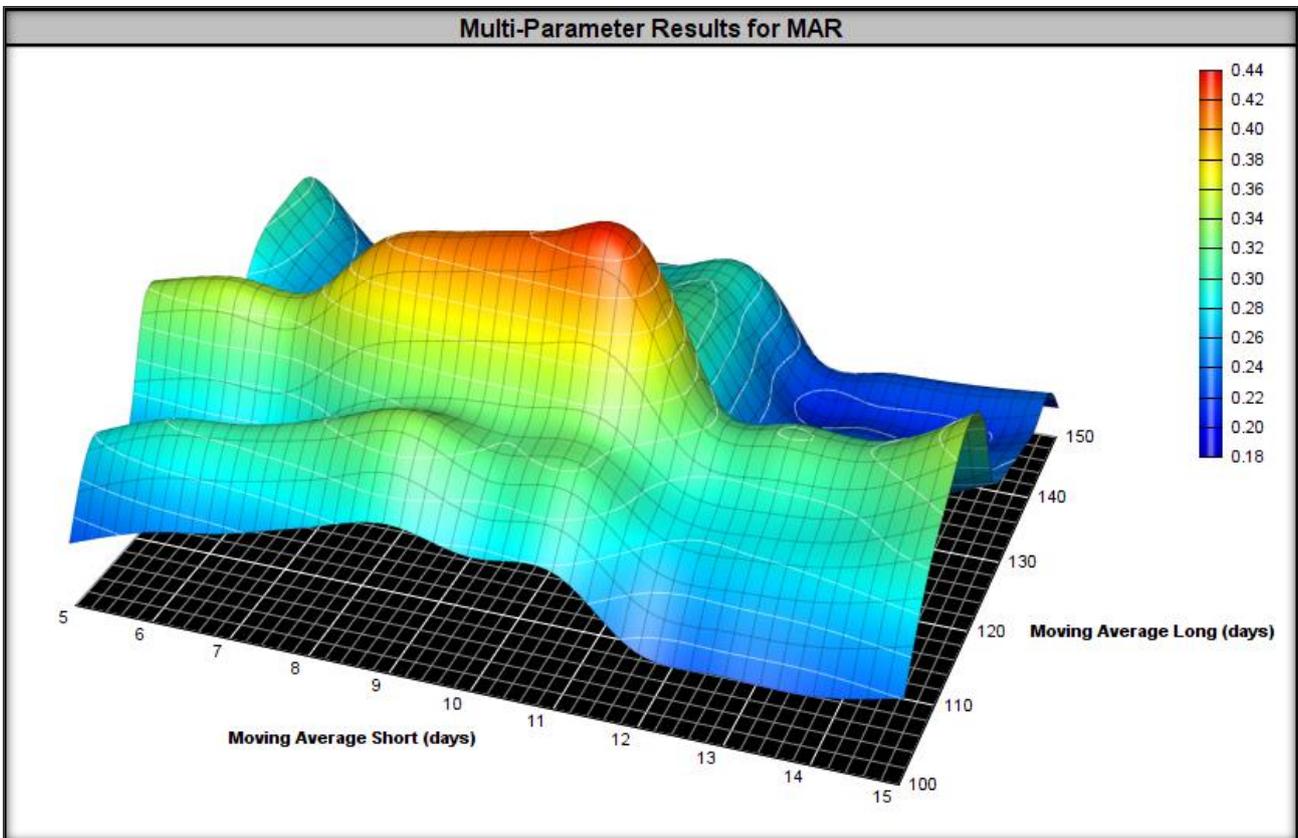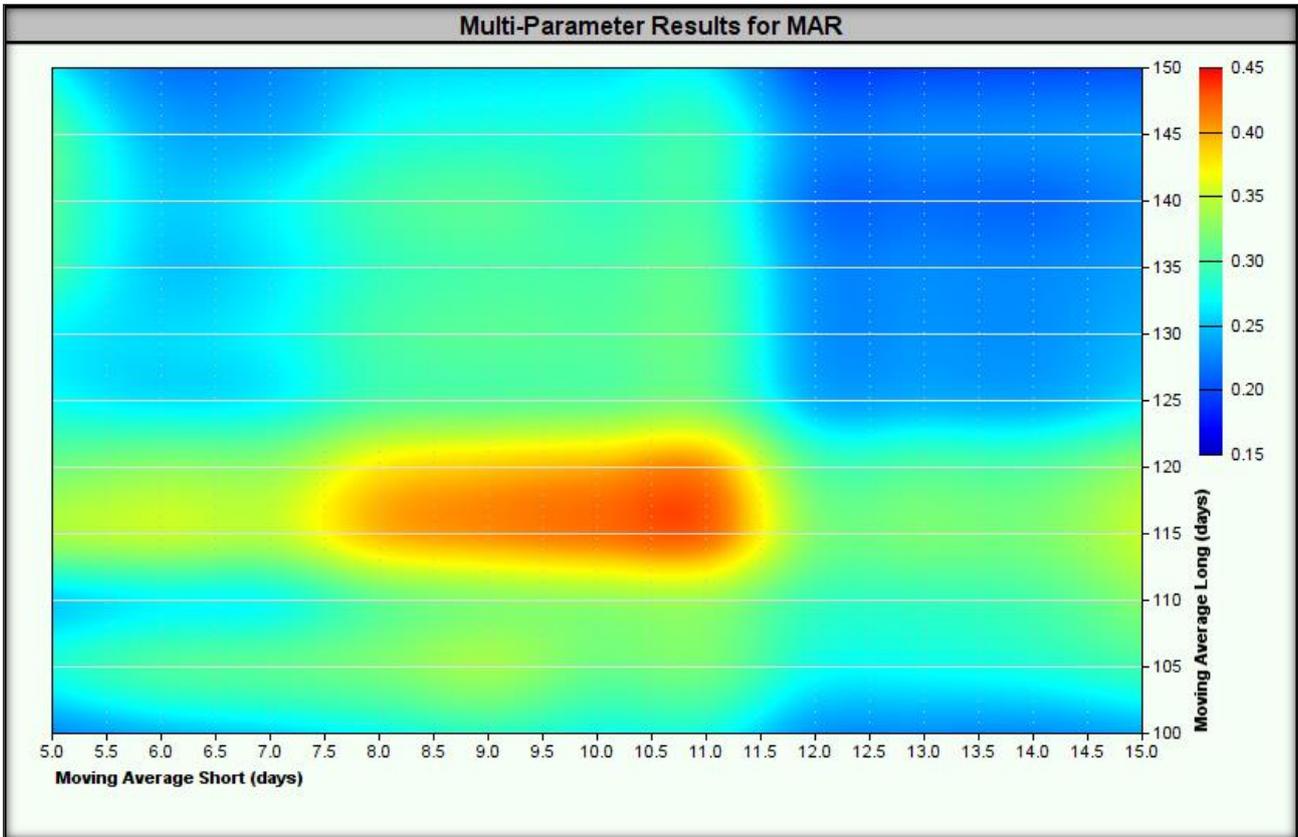
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.
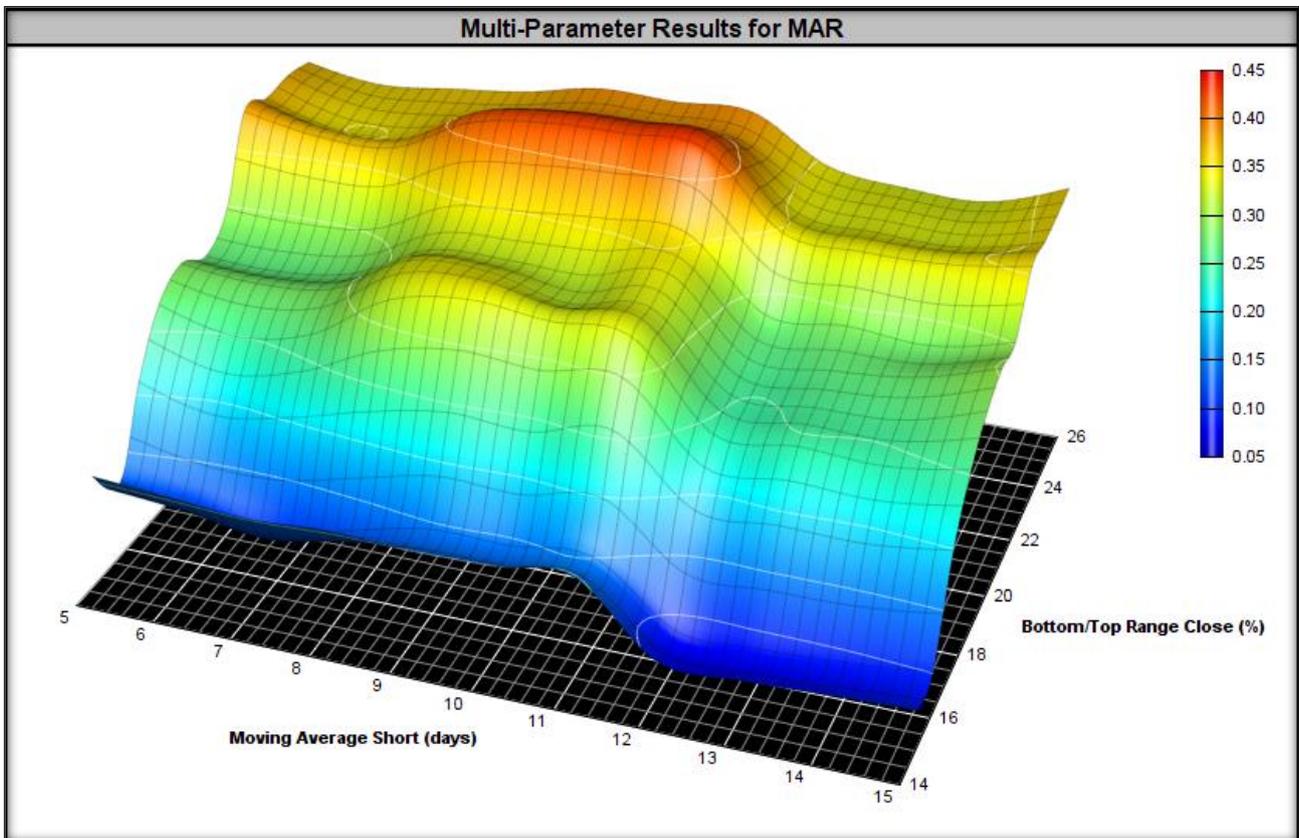
Test	Moving Average Short (days)	Moving Average Long (days)	Bottom/Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max T... ▽	Longest DD	Trades
242	6	150	25%	$113,670,088.73	9.56%	0.23	0.57	0.39	41.9%	60.5	378
241	6	150	24%	$114,857,141.10	9.69%	0.23	0.58	0.39	41.5%	60.7	370
363	7	150	25%	$112,561,182.78	9.45%	0.23	0.57	0.39	41.0%	60.5	371
240	6	150	23%	$117,312,324.35	9.95%	0.24	0.60	0.43	40.7%	60.5	355
1089	13	150	25%	$101,677,263.77	8.21%	0.20	0.52	0.50	40.4%	63.4	356
847	11	150	25%	$121,487,020.58	10.38%	0.26	0.62	0.44	40.4%	60.5	356
362	7	150	24%	$112,504,816.02	9.44%	0.23	0.57	0.39	40.4%	60.5	364
484	8	150	25%	$115,028,639.42	9.71%	0.24	0.58	0.42	40.3%	60.5	364
1210	14	150	25%	$100,424,292.87	8.07%	0.20	0.52	0.49	39.9%	63.3	359
968	12	150	25%	$102,259,627.17	8.28%	0.21	0.53	0.50	39.9%	63.3	355
846	11	150	24%	$121,896,999.16	10.42%	0.26	0.62	0.43	39.7%	60.5	348
605	9	150	25%	$117,861,261.67	10.01%	0.25	0.59	0.43	39.7%	60.5	358

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

- **All test results showed a positive 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 (41.9% vs. 36.3%)** – 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 (0.57 vs. 0.63)** – 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

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

Multi-Parameter Results for MAR

MAR as Moving Average Short (days) Varies

MAR as Moving Average Long (days) Varies

MAR as Bottom/Top Range Close (%) Varies
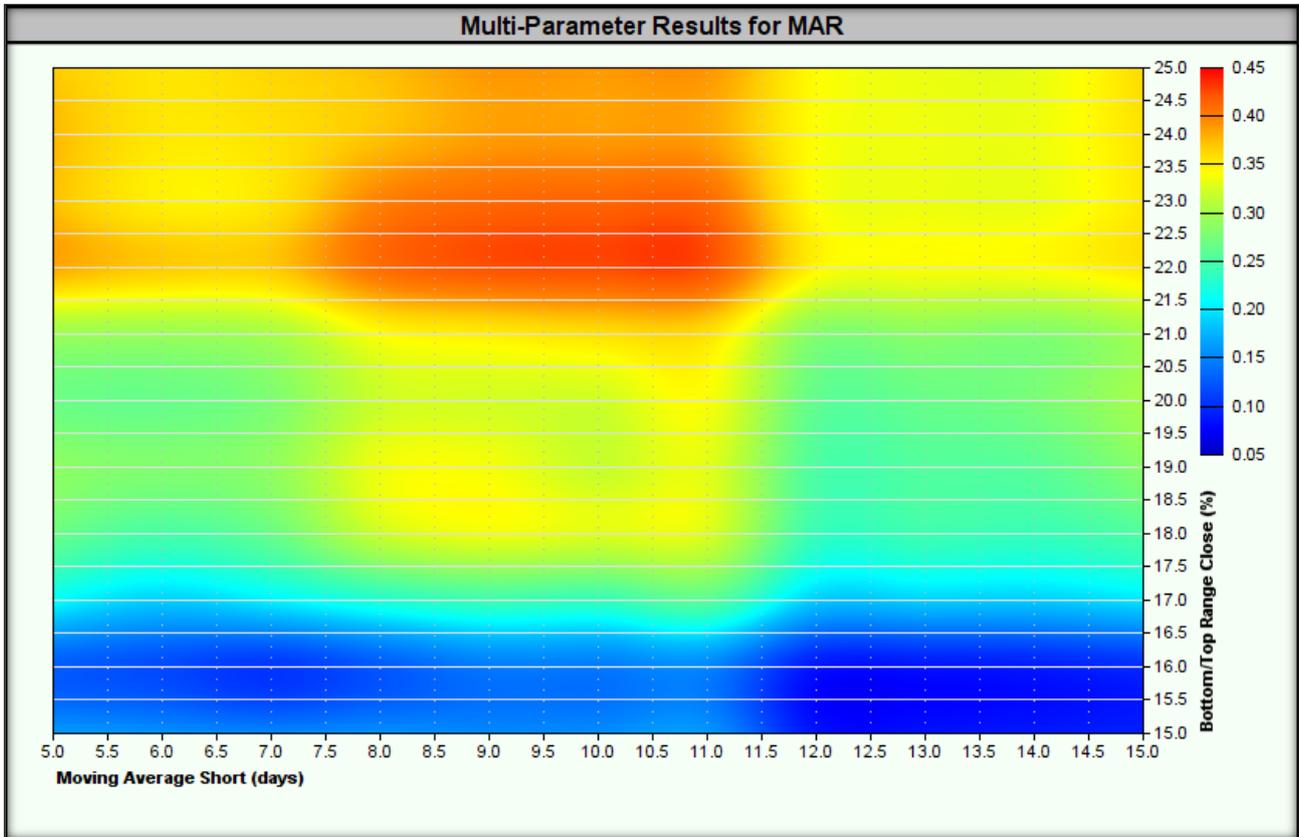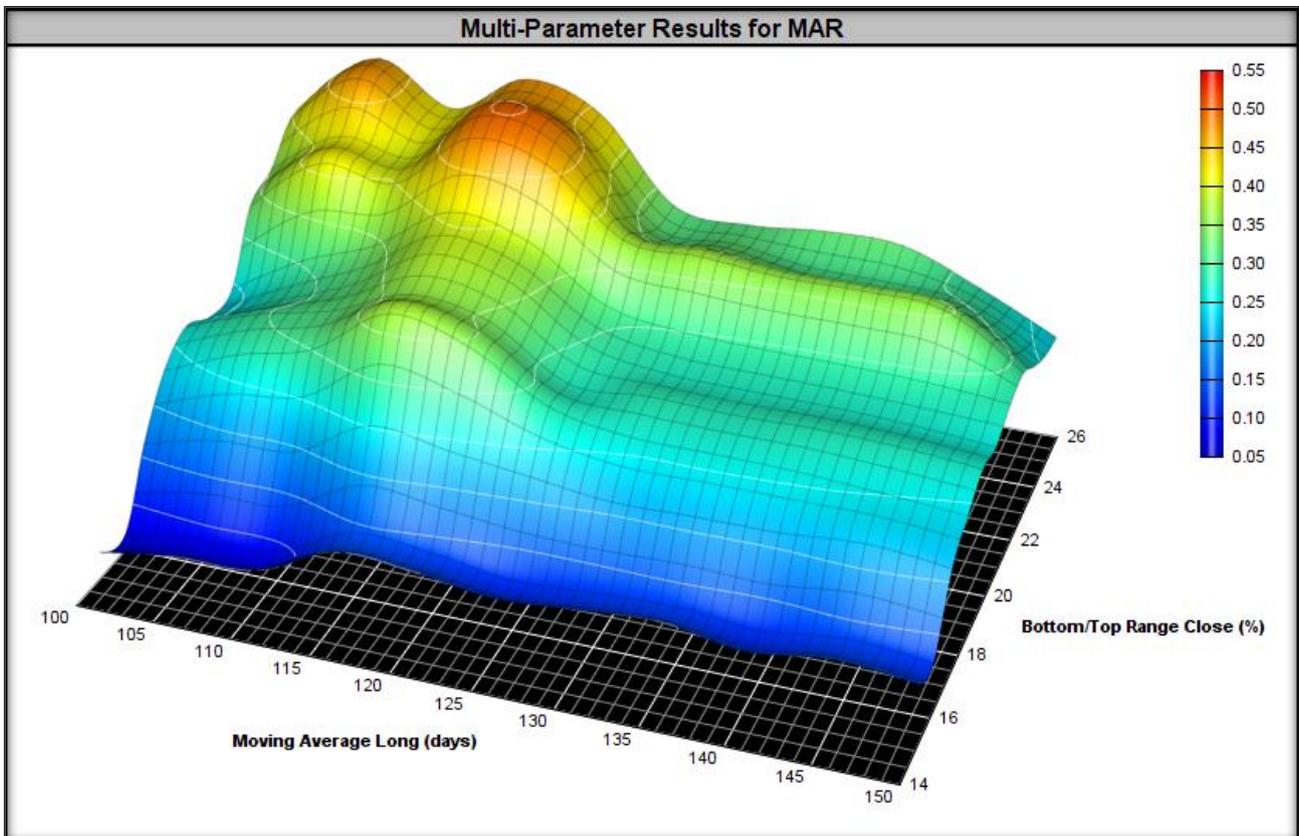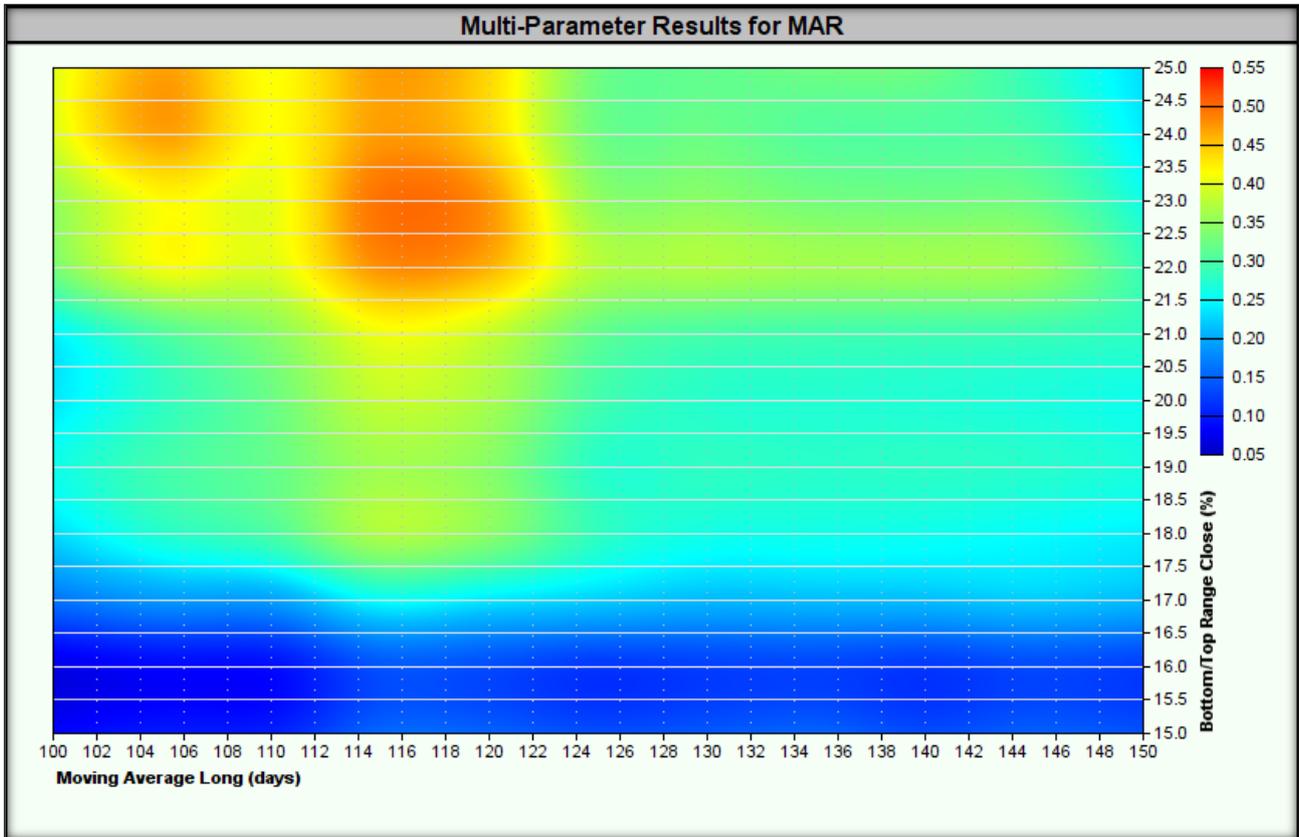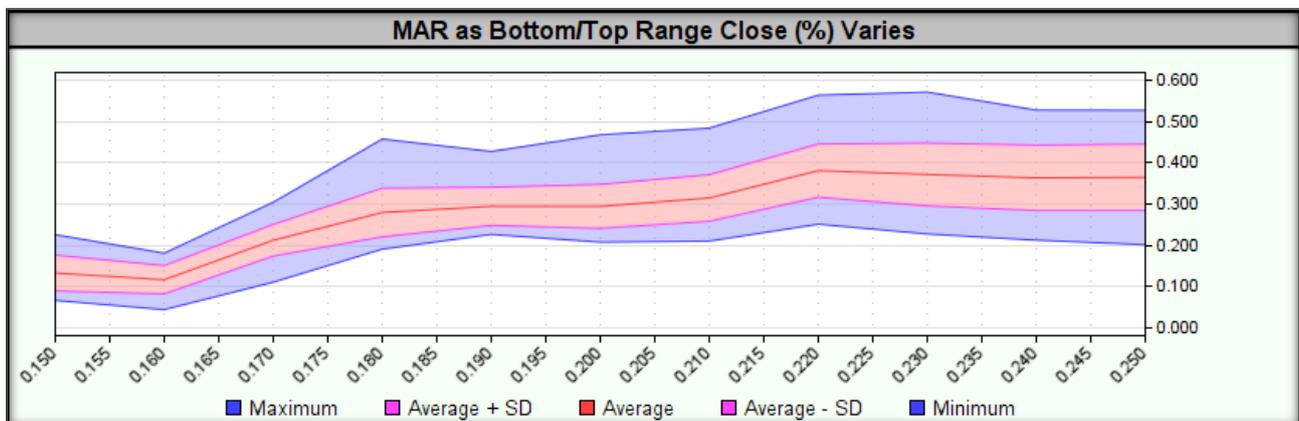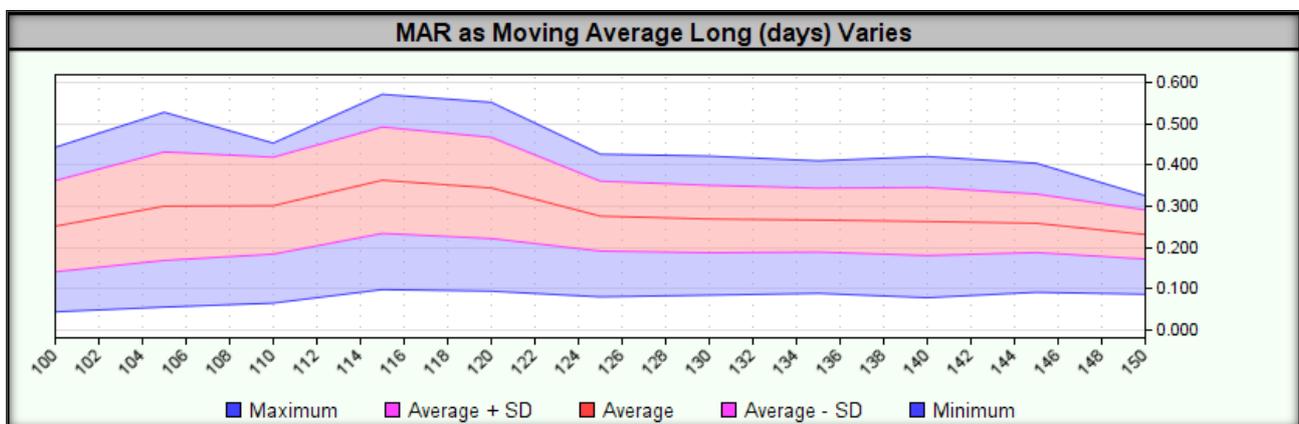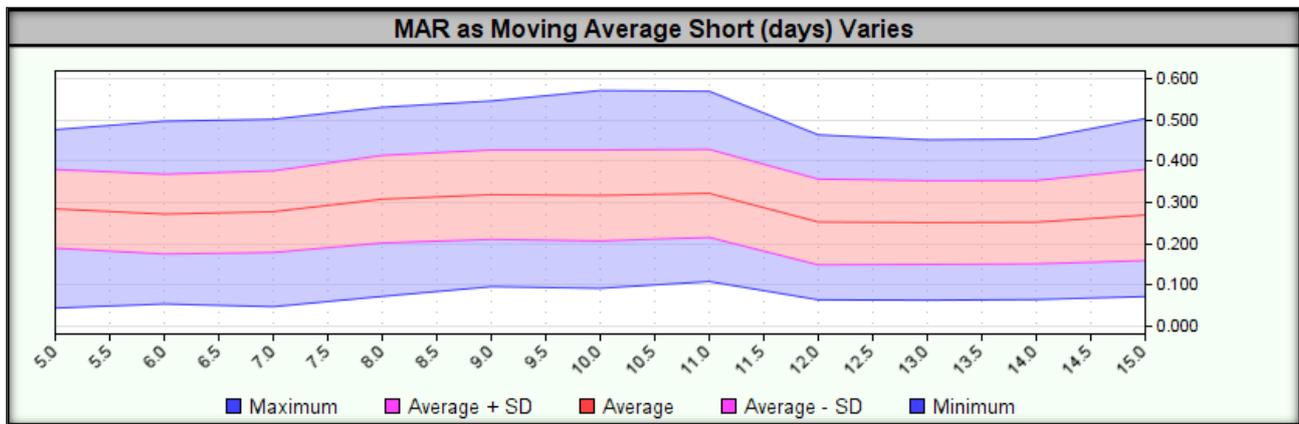
After passing **the stability test in a wide range of optimized parameters,** we can proceed to **stability testing using Monte Carlo simulation.** The conditions for passing this test are similar to those required in the above step.

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.
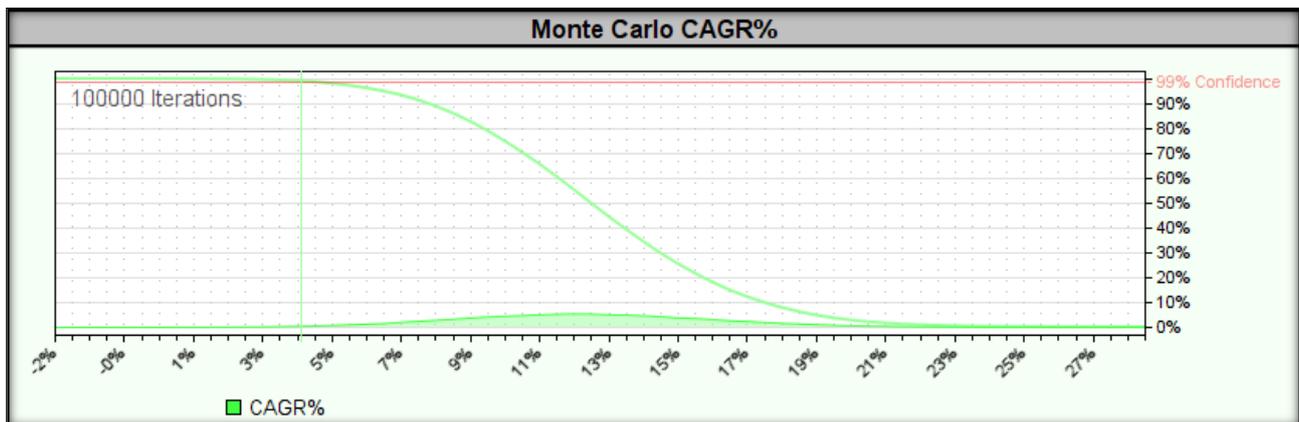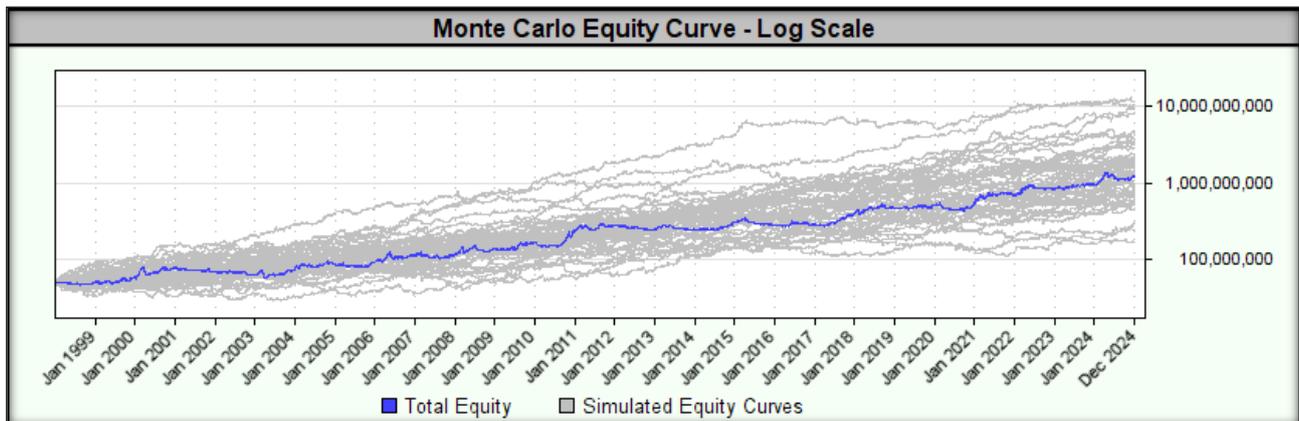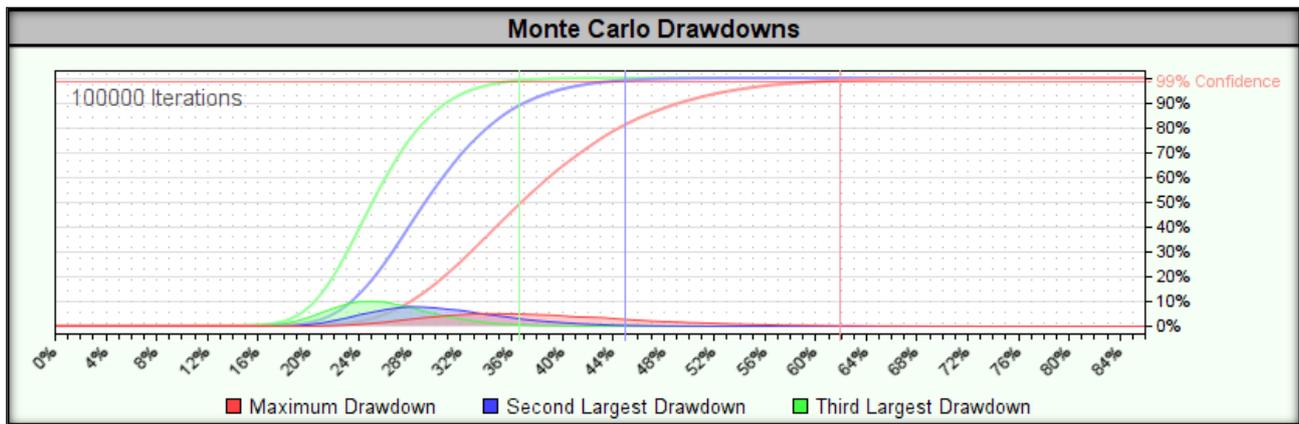
- **CAGR%** – In 99% of simulations achieved **a rate of return equal to or higher than 4%.**
- **Drawdown** – in 99% of simulations, **drawdown equal to or lower than 62% was achieved.** For parameters optimized on in-sample data, drawdown was 27.3%.

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	Long
1	19980101	$50,764,674.81	1.53%	0.17	0.27	1.99	8.9%	9.4	33	-18.81	-6.05	1.16	0.10	0.00
2	19990101	$59,685,930.20	19.44%	1.97	1.18	NA	9.8%	3.3	46	15.21	10.33	2.22	0.80	0.00
3	20000101	$60,205,890.93	20.68%	1.67	1.03	NA	12.3%	4.8	47	20.84	16.96	2.32	0.80	0.00
4	20010101	$45,273,186.37	-9.46%	-0.96	-1.25	-2.00	9.8%	11.7	32	-22.97	-8.95	0.19	-0.57	0.00
5	20020101	$46,570,225.38	-6.86%	-0.54	-0.76	-2.01	12.6%	7.4	60	-15.89	-10.41	0.66	-0.23	0.00
6	20030101	$58,333,766.34	16.68%	1.08	0.79	2.00	15.5%	7.1	50	14.15	8.83	2.02	0.69	0.00
7	20040101	$55,696,335.14	11.40%	1.42	1.11	NA	8.0%	3.0	50	23.61	16.18	1.71	0.42	0.00
8	20050101	$55,190,046.85	10.51%	1.02	0.95	NA	10.3%	8.7	53	-12.88	-5.17	1.62	0.40	0.00
9	20060101	$55,767,626.89	11.58%	0.63	0.72	2.00	18.5%	7.7	65	10.02	8.23	1.47	0.33	0.00
10	20070101	$51,780,431.25	3.56%	0.33	0.37	2.00	10.9%	5.4	50	-16.70	-6.95	1.28	0.18	0.00
11	20080101	$57,333,565.01	14.68%	0.91	0.70	NA	16.2%	5.9	41	16.79	9.00	2.15	0.68	0.00
12	20090101	$60,046,752.50	20.11%	1.69	1.47	2.00	11.9%	3.3	51	29.08	21.92	2.41	0.75	0.00
13	20100101	$75,871,208.54	51.96%	2.98	1.78	NA	17.4%	7.7	48	79.87	31.77	4.92	2.16	0.00
14	20110101	$55,422,076.37	10.98%	1.07	0.79	NA	10.2%	4.0	46	17.14	11.28	1.72	0.45	0.00
15	20120101	$44,637,508.10	-10.76%	-0.74	-1.28	NA	14.6%	11.3	53	-23.48	-13.59	0.45	-0.40	0.00
16	20130101	$49,353,303.78	-1.29%	-0.09	-0.07	-2.01	14.4%	7.4	51	-15.07	-7.80	0.93	-0.04	0.00
17	20140101	$60,840,461.99	21.70%	5.13	2.03	2.00	4.2%	3.5	51	16.10	11.26	2.43	0.87	0.00
18	20150101	$44,419,155.31	-11.17%	-0.68	-1.57	-2.00	16.4%	8.7	52	-21.97	-13.52	0.32	-0.43	0.00
19	20160101	$51,811,953.67	3.64%	0.37	0.39	NA	9.7%	6.7	53	7.73	4.18	1.25	0.15	0.00
20	20170101	$70,271,829.15	40.71%	5.76	2.85	2.01	7.1%	2.9	39	88.37	32.81	5.11	2.01	0.00
21	20180101	$49,679,688.05	-0.64%	-0.06	-0.01	-2.03	10.3%	7.3	49	0.45	0.25	0.97	-0.02	0.00
22	20190101	$52,185,755.31	4.37%	0.48	0.44	2.00	9.1%	3.9	61	-0.29	-0.23	1.22	0.14	0.00
23	20200101	$55,651,269.59	11.31%	0.73	0.70	NA	15.5%	10.8	62	-14.16	-10.52	1.67	0.43	0.00
24	20210101	$49,914,584.10	-0.17%	-0.02	0.03	NA	10.6%	6.0	64	5.65	4.62	1.01	0.01	0.00
25	20220101	$62,376,178.52	25.08%	1.74	1.36	NA	14.4%	6.7	45	50.57	21.29	3.00	1.08	0.00
26	20230101	$53,491,814.38	7.01%	0.81	0.74	2.00	8.6%	4.3	60	16.16	10.72	1.38	0.24	0.00
27	20240101	$50,553,376.30	1.11%	0.07	0.15	NA	15.3%	7.4	63	-13.31	-9.80	1.06	0.04	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	Long
1	19980101	$79,773,237.80	16.90%	0.81	0.86	1.35	20.8%	9.6	118	4.21	17.68	2.25	0.79	0.00
2	19990101	$68,155,192.61	10.89%	0.52	0.59	0.56	20.8%	11.7	119	4.30	18.21	1.83	0.54	0.00
3	20000101	$48,265,480.49	-1.17%	-0.05	-0.01	-0.08	22.5%	23.7	137	-0.46	-1.93	0.95	-0.03	0.00
4	20010101	$50,213,975.27	0.14%	0.01	0.09	0.01	23.1%	35.6	138	-2.15	-5.92	1.06	0.04	0.00
5	20020101	$64,906,859.24	9.09%	0.48	0.59	0.77	19.1%	9.3	152	2.24	10.47	1.59	0.38	0.00
6	20030101	$71,162,055.57	12.51%	0.81	0.79	2.21	15.5%	14.1	147	3.24	12.85	1.81	0.53	0.00
7	20040101	$72,791,711.82	13.37%	0.65	0.92	1.58	20.7%	14.3	159	3.18	10.67	1.77	0.53	0.00
8	20050101	$68,951,509.97	11.34%	0.55	0.79	1.11	20.7%	19.7	159	3.83	13.52	1.68	0.47	0.00
9	20060101	$66,283,808.09	9.87%	0.53	0.59	1.26	18.5%	11.7	149	2.50	10.08	1.61	0.42	0.00
10	20070101	$73,841,146.43	13.89%	0.86	0.81	1.86	16.2%	12.9	134	3.81	14.53	2.06	0.65	0.00
11	20080101	$98,886,587.82	25.54%	1.46	1.14	2.00	17.4%	12.9	133	3.98	12.19	3.12	1.20	0.00
12	20090101	$100,765,113.71	26.39%	1.51	1.26	2.16	17.4%	8.5	130	9.34	31.66	3.25	1.29	0.00
13	20100101	$78,999,134.83	16.48%	0.90	0.87	0.65	18.4%	15.6	134	6.84	25.35	2.40	0.89	0.00
14	20110101	$49,576,649.57	-0.28%	-0.02	0.04	-0.03	18.3%	27.6	146	-0.38	-1.26	1.01	0.00	0.00
15	20120101	$54,327,294.93	2.81%	0.18	0.31	0.21	16.0%	18.0	148	-0.93	-1.88	1.24	0.16	0.00
16	20130101	$55,155,861.32	3.33%	0.17	0.34	0.30	19.8%	18.0	145	1.84	7.04	1.30	0.19	0.00
17	20140101	$57,358,762.46	4.69%	0.22	0.47	0.38	21.5%	20.7	152	1.32	5.35	1.38	0.24	0.00
18	20150101	$63,346,765.72	8.23%	0.46	0.75	0.39	18.1%	28.5	140	0.41	1.04	1.71	0.43	0.00
19	20160101	$83,664,774.49	18.73%	1.30	1.18	1.28	14.4%	13.3	131	6.51	19.31	2.68	0.96	0.00
20	20170101	$89,310,253.84	21.37%	1.49	1.31	1.42	14.4%	15.7	138	8.43	23.49	2.69	0.99	0.00
21	20180101	$59,282,742.59	5.84%	0.26	0.48	1.26	22.2%	15.1	162	-0.18	-0.97	1.38	0.24	0.00
22	20190101	$71,127,195.01	12.48%	0.56	0.83	1.42	22.2%	10.5	164	2.36	12.96	1.90	0.56	0.00
23	20200101	$84,282,468.33	19.04%	1.23	1.12	3.33	15.5%	10.8	152	7.36	30.56	2.41	0.86	0.00
24	20210101	$68,445,078.86	11.04%	0.79	0.91	1.21	14.1%	15.1	164	4.18	13.96	1.65	0.41	0.00
25	20220101	$90,294,265.05	21.84%	1.01	1.21	3.39	21.5%	15.1	157	4.22	16.85	2.32	0.83	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): 23 out of 25 periods** ended with a positive rate of return (**92%**).

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 180's v.2 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
C	10	20.8%	38	79.2%	48	265	81.8%	59	18.2%	4.27%	0.42%	0.56%	2.71
CC	8	16.0%	42	84.0%	50	267	82.4%	57	17.6%	5.16%	0.48%	0.42%	2.06
CFI	11	32.4%	23	67.6%	34	279	86.1%	45	13.9%	5.01%	0.34%	1.39%	6.96
CL	13	21.7%	47	78.3%	60	252	77.8%	72	22.2%	1.96%	0.43%	0.09%	1.26
CT	13	25.0%	39	75.0%	52	260	80.2%	64	19.8%	3.07%	0.43%	0.45%	2.39
DX	15	30.0%	35	70.0%	50	264	81.5%	60	18.5%	3.17%	0.47%	0.62%	2.89
EBL	11	20.4%	43	79.6%	54	254	78.4%	70	21.6%	2.15%	0.42%	0.10%	1.30
ES	21	26.2%	59	73.8%	80	234	72.2%	90	27.8%	1.55%	0.45%	0.08%	1.23
FDX	10	19.6%	41	80.4%	51	268	82.7%	56	17.3%	1.18%	0.44%	-0.12%	0.66
FLG	8	18.2%	36	81.8%	44	268	82.7%	56	17.3%	3.29%	0.48%	0.20%	1.51
GC	9	18.8%	39	81.2%	48	262	80.9%	62	19.1%	1.13%	0.37%	-0.09%	0.70
HG	9	18.8%	39	81.2%	48	266	82.1%	58	17.9%	6.10%	0.46%	0.77%	3.06
HSI	15	33.3%	30	66.7%	45	261	80.6%	63	19.4%	2.30%	0.45%	0.47%	2.54
KC	9	24.3%	28	75.7%	37	273	84.3%	51	15.7%	1.72%	0.34%	0.16%	1.61
LCO	19	33.9%	37	66.1%	56	250	77.2%	74	22.8%	2.17%	0.44%	0.45%	2.53
LGO	9	25.0%	27	75.0%	36	275	84.9%	49	15.1%	6.40%	0.47%	1.25%	4.57
NG	10	16.4%	51	83.6%	61	259	79.9%	65	20.1%	1.74%	0.42%	-0.06%	0.82
NIY	12	25.0%	36	75.0%	48	263	81.2%	61	18.8%	2.39%	0.53%	0.20%	1.51
NQ	18	20.9%	68	79.1%	86	226	69.8%	98	30.2%	2.07%	0.43%	0.09%	1.26
OJ	11	23.9%	35	76.1%	46	265	81.8%	59	18.2%	1.98%	0.47%	0.11%	1.31
PA	7	31.8%	15	68.2%	22	293	90.4%	31	9.6%	3.90%	0.42%	0.95%	4.32
S	13	21.7%	47	78.3%	60	253	78.1%	71	21.9%	2.91%	0.46%	0.27%	1.77
SB	12	28.6%	30	71.4%	42	271	83.6%	53	16.4%	3.71%	0.42%	0.76%	3.54
TY	15	30.6%	34	69.4%	49	255	78.7%	69	21.3%	2.43%	0.46%	0.42%	2.32
W	6	11.3%	47	88.7%	53	264	81.5%	60	18.5%	1.34%	0.43%	-0.23%	0.40

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
C	7	26.9%	19	73.1%	26	293	90.4%	31	9.6%	2.45%	0.41%	0.36%	2.18
CC	2	25.0%	6	75.0%	8	310	95.7%	14	4.3%	12.56%	0.52%	2.75%	8.01
CFI	6	33.3%	12	66.7%	18	296	91.4%	28	8.6%	1.12%	0.33%	0.15%	1.70
CL	6	20.0%	24	80.0%	30	279	86.1%	45	13.9%	2.68%	0.48%	0.16%	1.41
CT	7	25.9%	20	74.1%	27	293	90.4%	31	9.6%	0.63%	0.41%	-0.14%	0.54
DX	7	25.0%	21	75.0%	28	290	89.5%	34	10.5%	1.72%	0.52%	0.04%	1.10
EBL	2	12.5%	14	87.5%	16	302	93.2%	22	6.8%	3.01%	0.46%	-0.03%	0.93
ES	9	19.6%	37	80.4%	46	267	82.4%	57	17.6%	1.29%	0.48%	-0.13%	0.65
FDX	2	9.5%	19	90.5%	21	298	92.0%	26	8.0%	0.48%	0.44%	-0.35%	0.12
FLG	4	30.8%	9	69.2%	13	306	94.4%	18	5.6%	3.20%	0.48%	0.65%	2.94
GC	2	14.3%	12	85.7%	14	305	94.1%	19	5.9%	0.59%	0.35%	-0.21%	0.29
HG	1	4.8%	20	95.2%	21	295	91.0%	29	9.0%	8.53%	0.44%	-0.01%	0.98
HSI	4	13.3%	26	86.7%	30	285	88.0%	39	12.0%	2.79%	0.54%	-0.09%	0.80
KC	2	15.4%	11	84.6%	13	308	95.1%	16	4.9%	0.69%	0.41%	-0.24%	0.31
LCO	9	30.0%	21	70.0%	30	284	87.7%	40	12.3%	2.61%	0.48%	0.45%	2.32
LGO	3	21.4%	11	78.6%	14	304	93.8%	20	6.2%	5.68%	0.51%	0.82%	3.06
NG	8	32.0%	17	68.0%	25	291	89.8%	33	10.2%	1.62%	0.42%	0.23%	1.82
NIY	5	20.8%	19	79.2%	24	292	90.1%	32	9.9%	2.94%	0.55%	0.18%	1.41
NQ	8	15.4%	44	84.6%	52	258	79.6%	66	20.4%	1.89%	0.47%	-0.11%	0.73
OJ	8	28.6%	20	71.4%	28	287	88.6%	37	11.4%	1.78%	0.41%	0.22%	1.74
PA	4	26.7%	11	73.3%	15	304	93.8%	20	6.2%	4.65%	0.44%	0.92%	3.87
S	7	18.9%	30	81.1%	37	275	84.9%	49	15.1%	2.50%	0.48%	0.08%	1.21
SB	9	31.0%	20	69.0%	29	286	88.3%	38	11.7%	2.46%	0.44%	0.46%	2.50
TY	3	12.0%	22	88.0%	25	293	90.4%	31	9.6%	1.64%	0.49%	-0.24%	0.46
W	4	13.3%	26	86.7%	30	288	88.9%	36	11.1%	0.92%	0.43%	-0.25%	0.33

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 84%;**
- **The portfolio with the lowest MAR** (obtained on IS data) has a percentage of instruments with **profit factor > 1 at the level of 56%.**

Thus, **the stability test of the strategy on the financial instruments portfolio was not passed.** Therefore, **further testing of the strategy is not justified,** because its use in real transactions **is highly doubtful.**

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

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

Step 6: Using the strategy in real time

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