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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.

180's v.1

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.

The strategy was tested on **parameters suggested by the strategy creator, Jeff Cooper:**

- **Short Moving Average (SMA) Length:** 10 days;
- **Long Moving Average (SMA) Length:** 50 days;
- **Formation candle:**
  - **The closing price of the first candle** is in **the lower 25% of the daily range and below the opening price;**
  - **The closing price of the second candle** is in **the upper 25% of the daily range and above the opening price;**
  - **The closing price of the second candle** is **above both the 10-day and 50-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 1.0% of total capital;
- **Position direction:** long positions (buy) only.

It should be noted that while the strategy's 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 conducted 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.

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 **stock indices, bonds, gold** and **the dollar index;**
- **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 25% of the daily range and below the opening price.**
    b. **On the second day,** the closing price must be within **the upper 25% of the daily range and above the opening price.**
2. **Trend Confirmation:** The second day's closing price must be above both the 10-day and 50-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 50-day 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:** 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 **1.0% 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.**

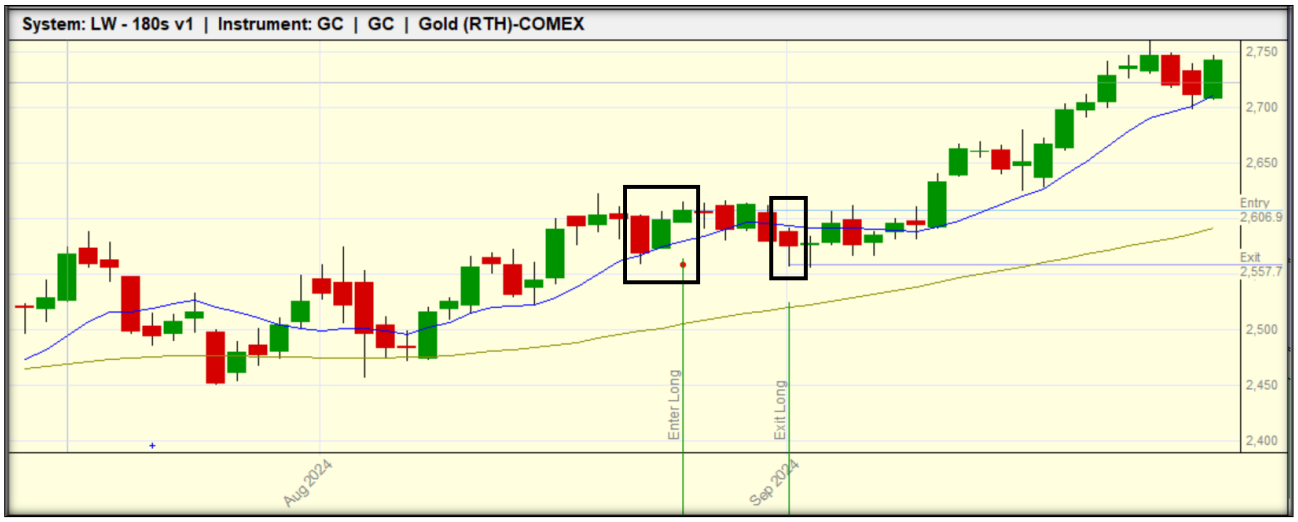
At this stage **it does not matter** whether the transactions are **profitable,** what **instrument was used** or whether they took place **recently** or **in the distant past.** The key is **to check whether the transactions are generated correctly** and in accordance with the assumptions described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

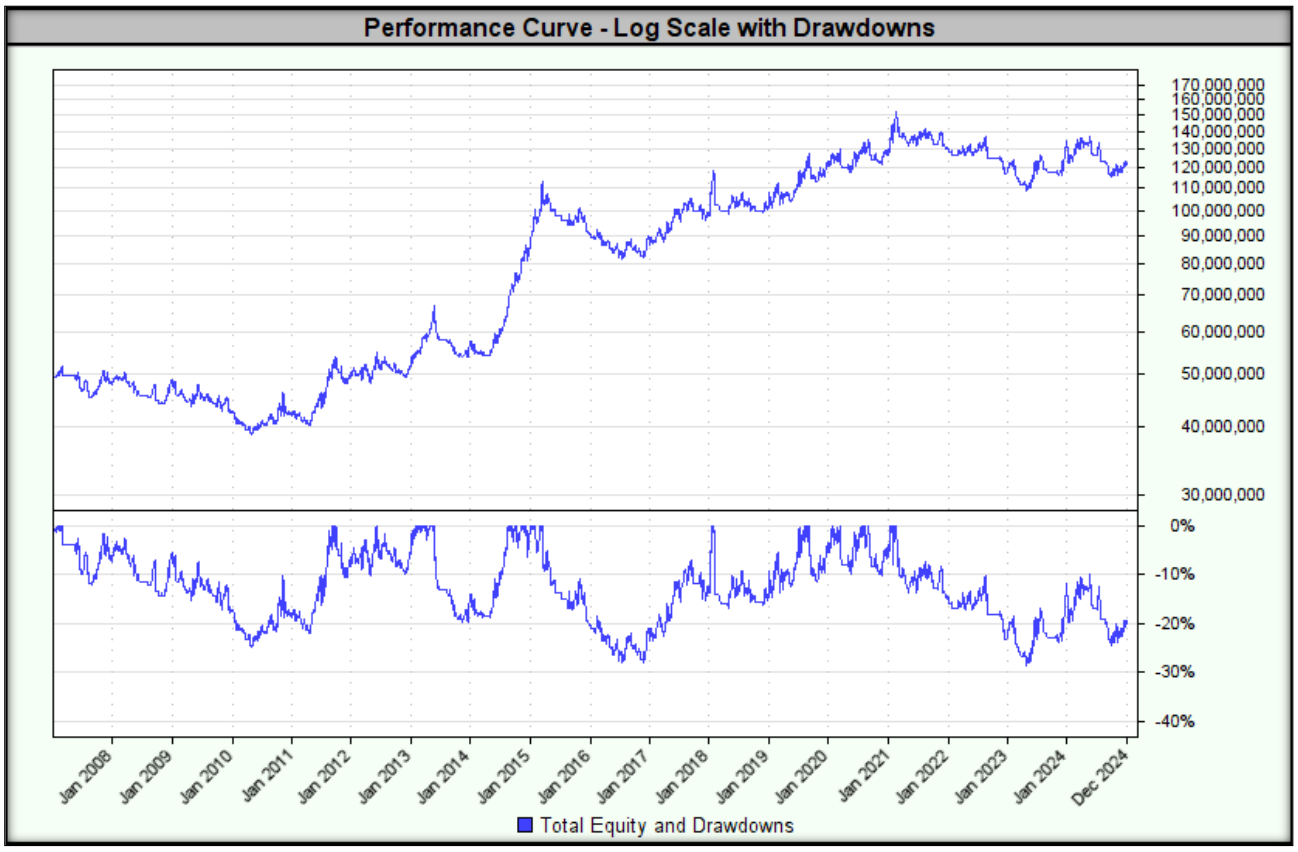
Tested base parameters:

- **Short Moving Average (SMA) Length:** 10 days;
- **Long Moving Average (SMA) Length:** 50 days;
- **Formation candle:**
  - **The closing price of the first candle** is in **the lower 25% of the daily range and below the opening price;**
  - **The closing price of the second candle** is in **the upper 25% of the daily range and above the opening price;**
  - **The closing price of the second candle** is **above both the 10-day and 50-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 1.0% 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.



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%	5.1%
MAR Ratio	0.18
RAR%	8.0%
R-Cubed	0.15
Robust Sharpe Ratio	0.59
Max Drawdown	28.5%
Wins	25.4%
Losses	74.6%
Average Win%	3.57%
Average Loss %	0.84%
Win/ Loss Ratio	3.83
Average Trade Duration (days)	29
Percent Profit Factor	1.44

SQN	0.37
Number of transactions	445

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

Strategy 180's v.1 assumes the use **of parameters optimized by Jeff Cooper.** This means that **we do not optimize the parameters themselves,** but only examine **whether the strategy behaves stably** on **in-sample** and **out-of-sample data.**

1. Stability across a wide range of optimized parameters

In the first step, we test the stability of the parameters on **the in-sample data.** For this purpose, we determine **the ranges of values** for all optimized parameters 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 **8-12 days (step: 1);**
- **Long Moving Average (SMA) Lengths: 40-60 day** range **(step: 2);**
- **Formation candle:**
  - **Lower closing range of the first candle:** range **20%-30% (step: 1 pp.);**
  - **Upper closing range of the second candle:** range **20%-30% (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 0.04 was achieved for the following parameters:

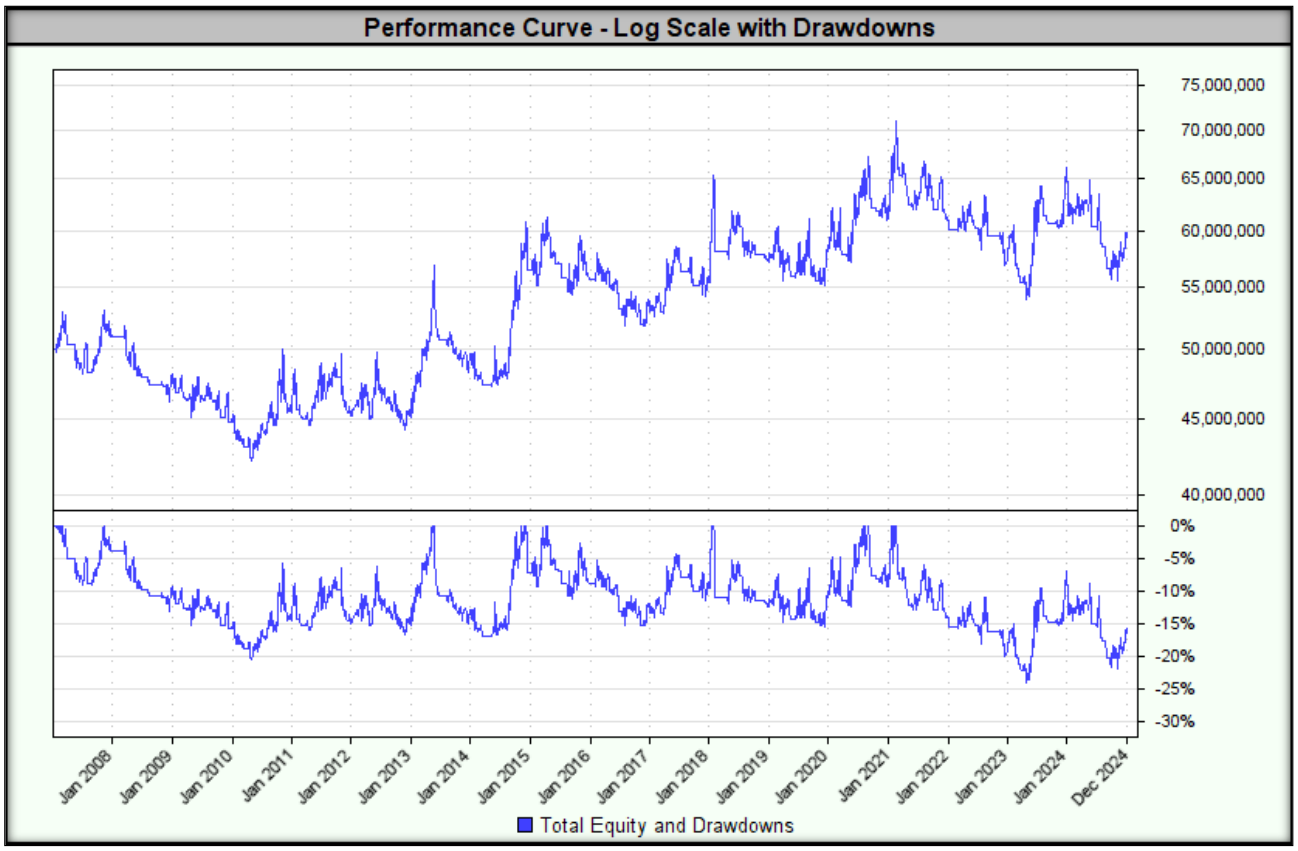
- **Short Moving Average (SMA) Lengths:** 12;
- **Long Moving Average (SMA) Lengths:** 40;
- **Formation candle:**
  - **Lower closing range of the first candle:** 20%;
  - **Upper closing range of the second candle:** 24%.

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 Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD
5331	12	40	20%	76%	$59,874,954.12	1.01%	0.04	0.15	0.16	24.1%	65.9
5342	12	40	21%	76%	$61,581,661.54	1.16%	0.05	0.16	0.17	25.4%	74.3
5332	12	40	20%	77%	$62,113,939.34	1.21%	0.05	0.17	0.20	24.1%	74.3
5330	12	40	20%	75%	$62,535,716.63	1.25%	0.05	0.17	0.20	24.1%	65.7
4000	11	40	20%	76%	$62,721,898.81	1.27%	0.05	0.17	0.21	24.1%	65.9
5825	12	48	21%	75%	$67,376,689.45	1.67%	0.05	0.20	0.19	31.7%	117.7
5343	12	40	21%	77%	$63,555,599.08	1.34%	0.05	0.18	0.20	25.2%	74.3
5826	12	48	21%	76%	$67,411,866.80	1.67%	0.05	0.20	0.18	30.8%	117.7
3152	10	48	20%	75%	$68,738,011.63	1.78%	0.06	0.21	0.24	32.3%	117.7

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 0.29 was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 9;
- **Long Moving Average (SMA) Lengths:** 52;
- **Formation candle:**
  - **Lower closing range of the first candle:** 24%;
  - **Upper closing range of the second candle:** 20%.

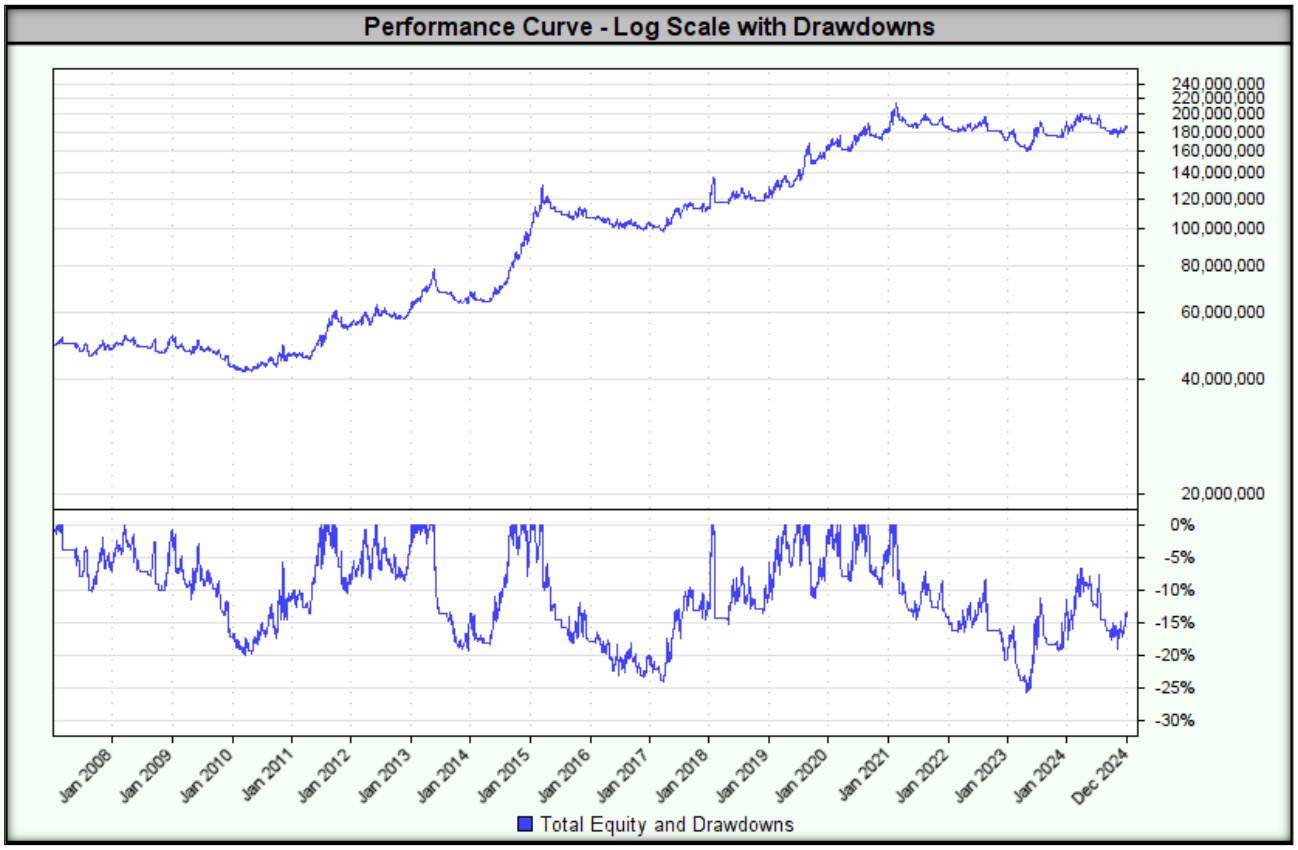
The highest MAR value was accompanied by **a drawdown of 25.8%.**

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 Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD
2112	9	52	24%	80%	$186,619,014.81	7.59%	0.29	0.62	0.56	25.8%	46.4
1990	9	50	24%	79%	$175,416,673.70	7.22%	0.29	0.60	0.58	24.6%	53.0
2111	9	52	24%	79%	$184,445,767.41	7.52%	0.29	0.61	0.56	25.6%	46.4
1265	8	60	24%	80%	$187,812,408.10	7.63%	0.29	0.60	0.65	26.0%	46.4
1991	9	50	24%	80%	$177,626,998.64	7.30%	0.29	0.61	0.58	25.0%	53.4
2596	9	60	24%	80%	$193,880,980.92	7.82%	0.29	0.61	0.58	26.8%	51.4
1264	8	60	24%	79%	$186,918,972.03	7.60%	0.29	0.60	0.65	26.2%	46.4
2595	9	60	24%	79%	$192,821,192.46	7.79%	0.29	0.60	0.57	27.0%	46.4
1263	8	60	24%	78%	$185,715,315.68	7.56%	0.29	0.60	0.60	26.4%	46.4

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 41.3%.**

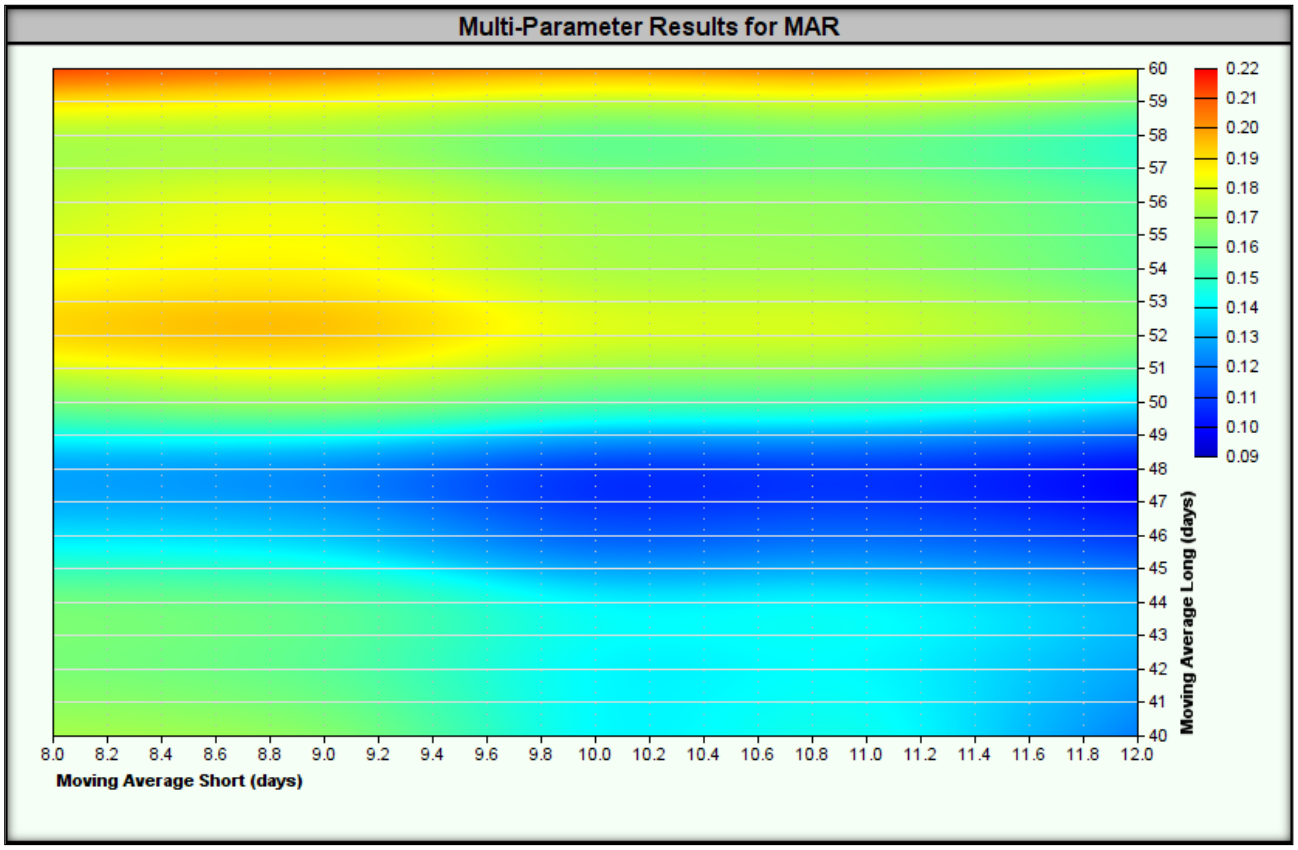
Historical or simulated results do not guarantee that similar outcomes will be achieved in the future.

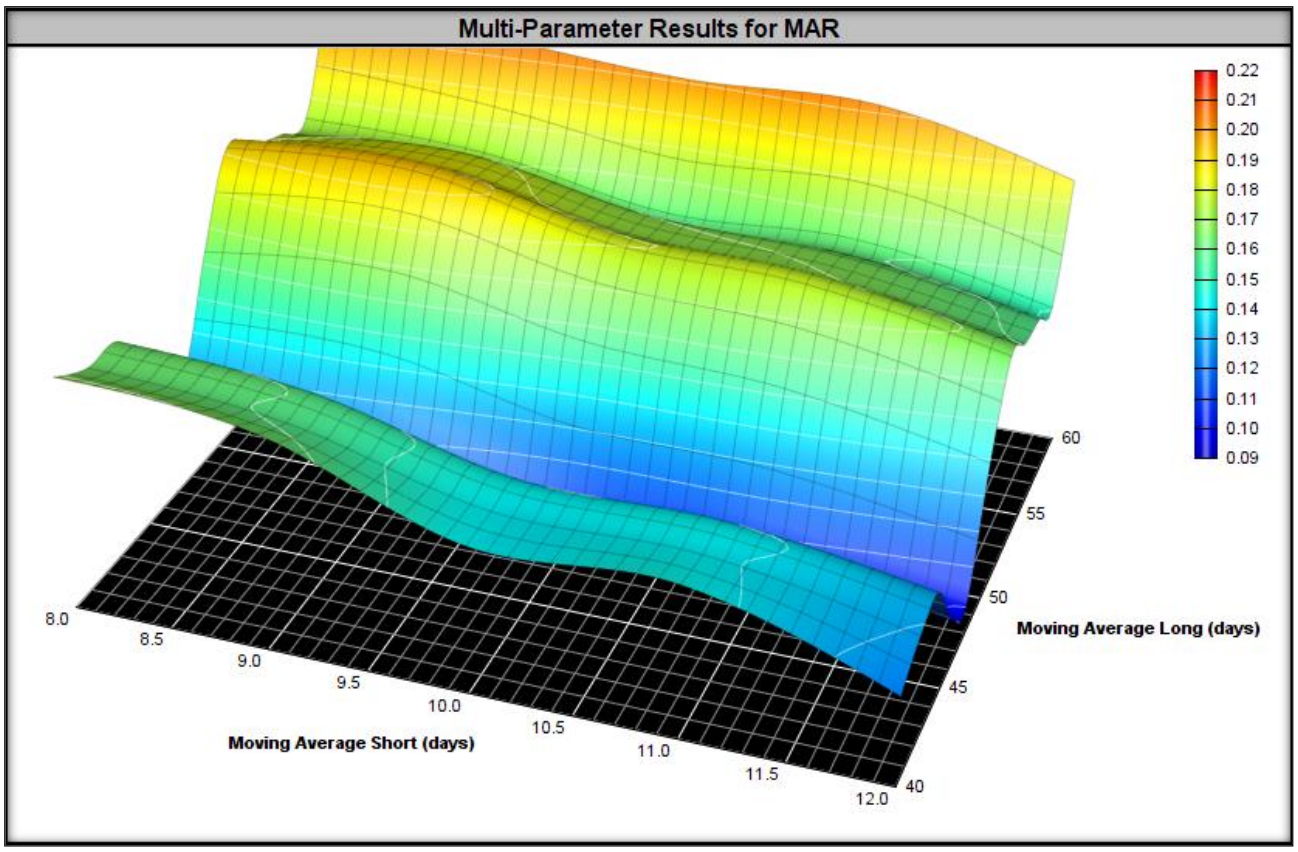
Test	Moving Average Short (days)	Moving Average Long (days)	Bottom Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD
6030	12	50	29%	71%	$83,867,885.20	2.92%	0.07	0.26	0.18	41.3%	74.1
6041	12	50	30%	71%	$80,413,272.69	2.68%	0.06	0.25	0.17	41.2%	74.5
6029	12	50	29%	70%	$82,370,002.82	2.81%	0.07	0.26	0.19	40.3%	72.2
3158	10	48	21%	70%	$77,930,464.40	2.50%	0.06	0.26	0.23	39.6%	117.7
6040	12	50	30%	70%	$79,019,931.38	2.58%	0.07	0.24	0.18	39.6%	72.3
3048	10	46	22%	70%	$104,677,405.67	4.19%	0.11	0.39	0.31	39.3%	117.7
6150	12	52	29%	70%	$96,146,727.38	3.70%	0.09	0.31	0.22	39.2%	70.7
6151	12	52	29%	71%	$97,487,777.57	3.78%	0.10	0.31	0.21	39.2%	72.3
6514	12	58	29%	71%	$87,751,681.26	3.17%	0.08	0.27	0.19	39.1%	72.2

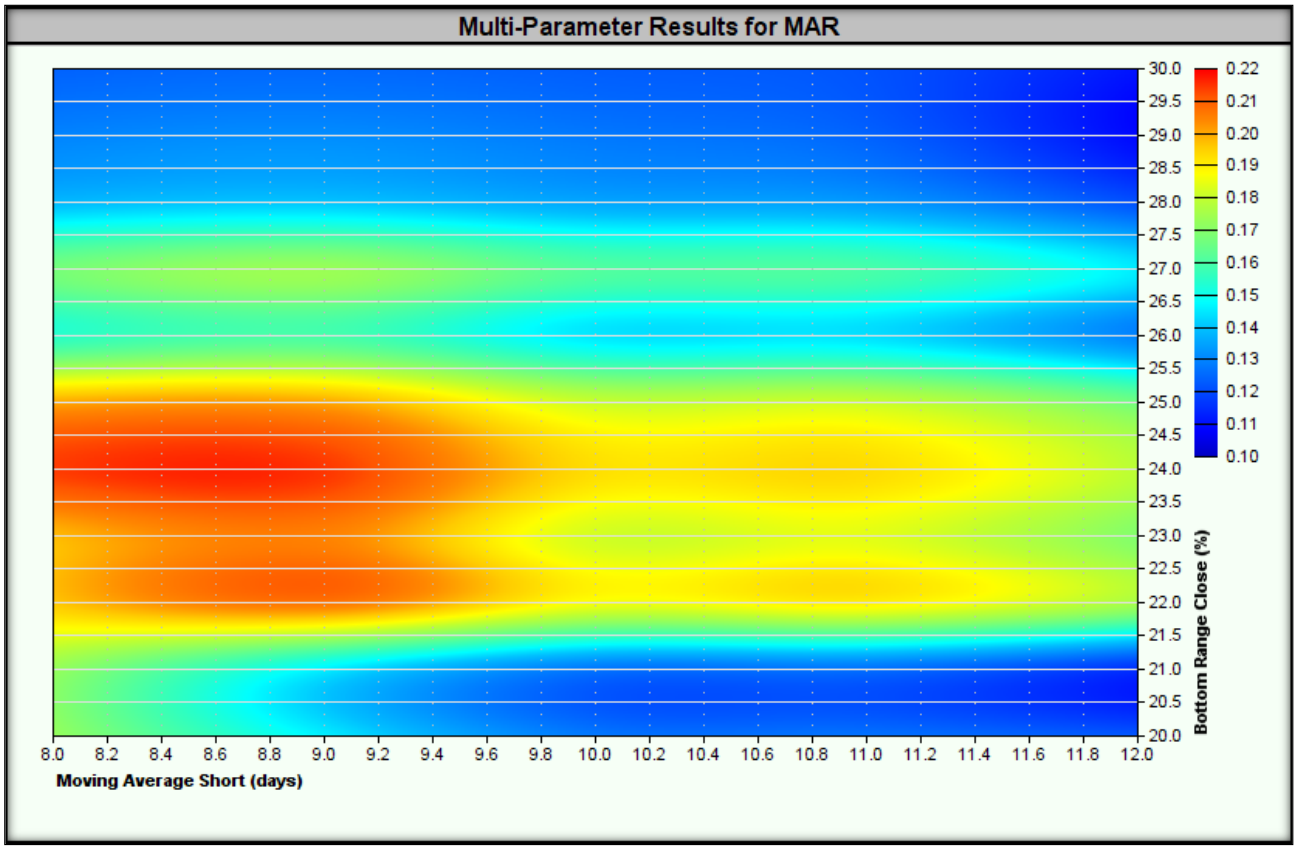
In summary, the strategy **passed the stability test** in a wide range of optimized parameters on in-sample data because:

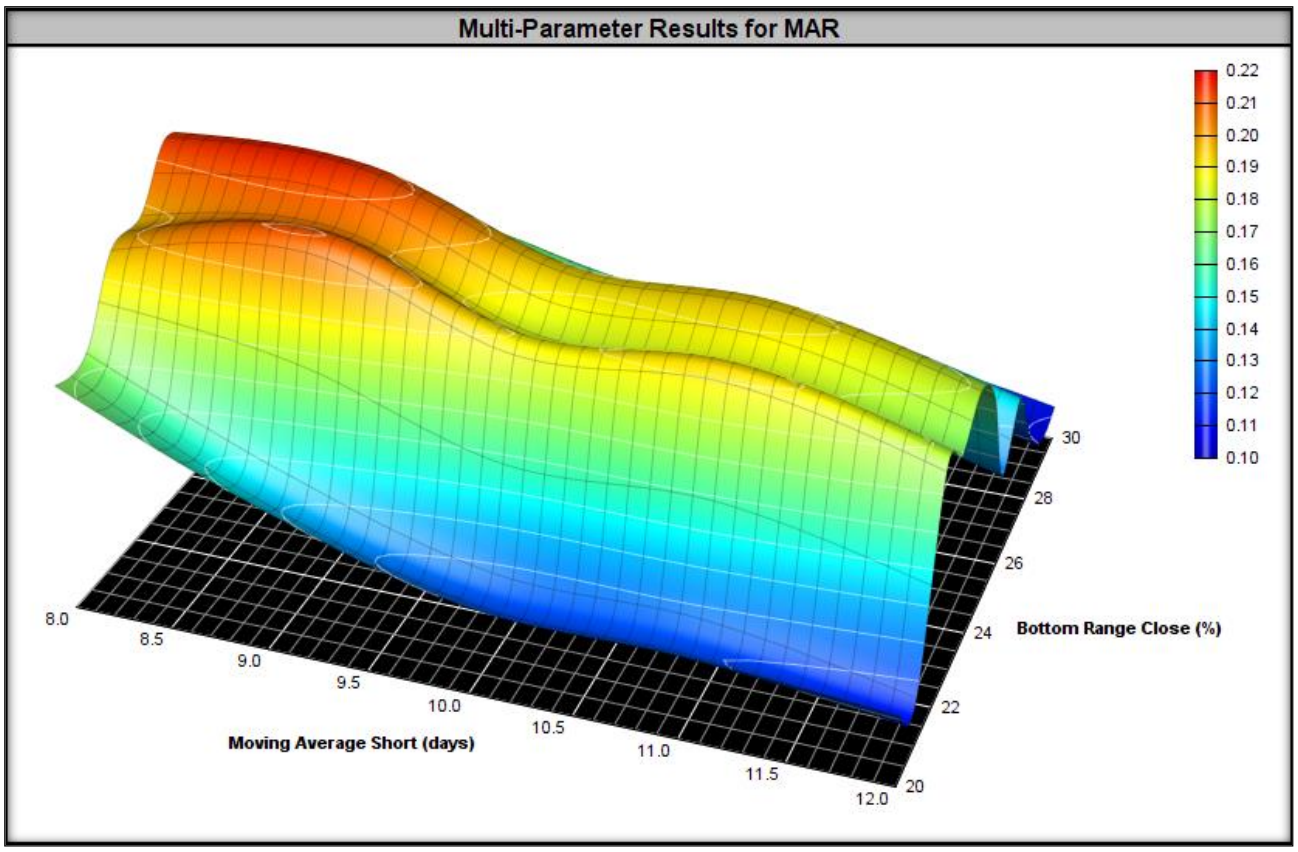
- **MAR value** – which indicates the stability of the strategy in various market conditions.
- **The maximum drawdown did not exceed 250% of the drawdown value** for the result with the highest MAR (**41.3% vs. 25.8%)** – which means an acceptable risk of deep capital drawdowns.

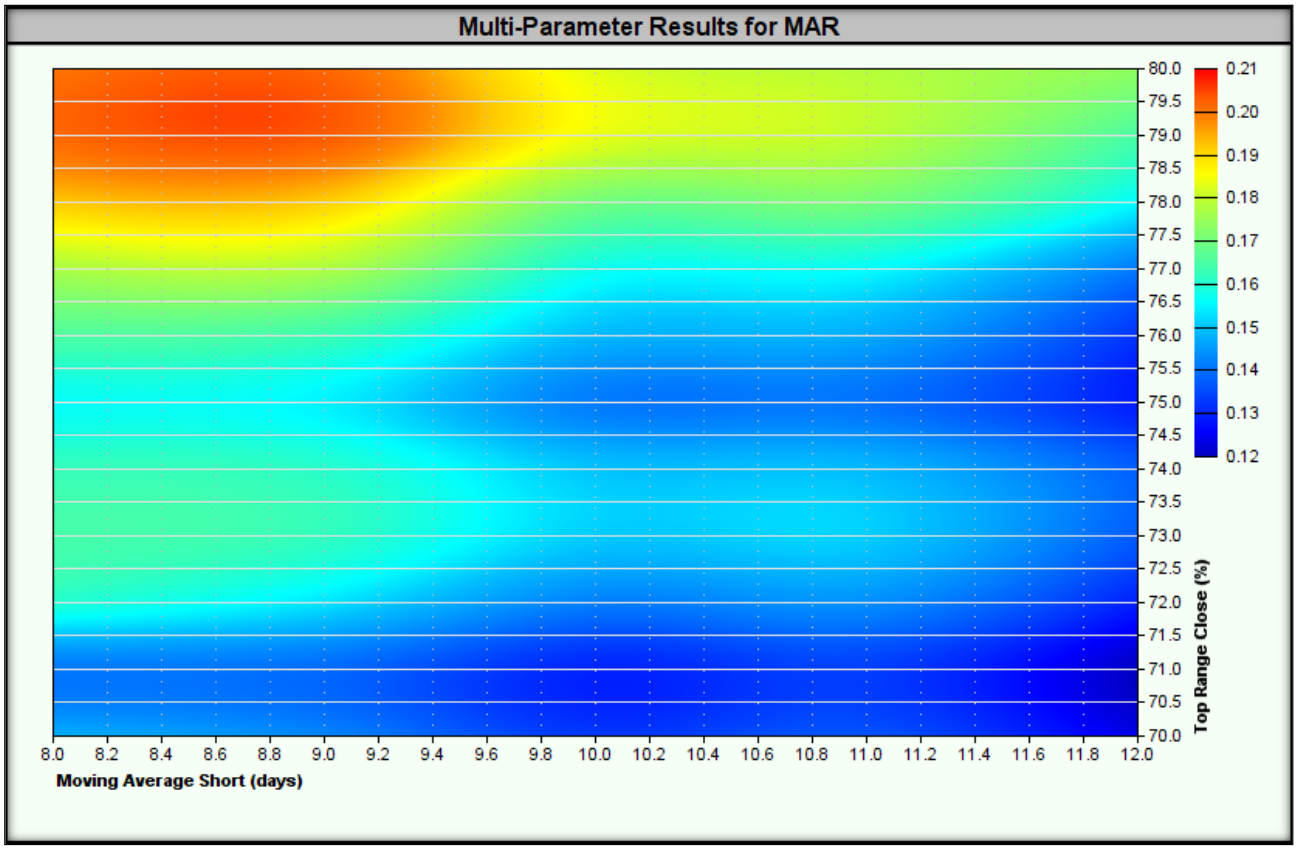
Heatmaps for the tested ranges are presented below.

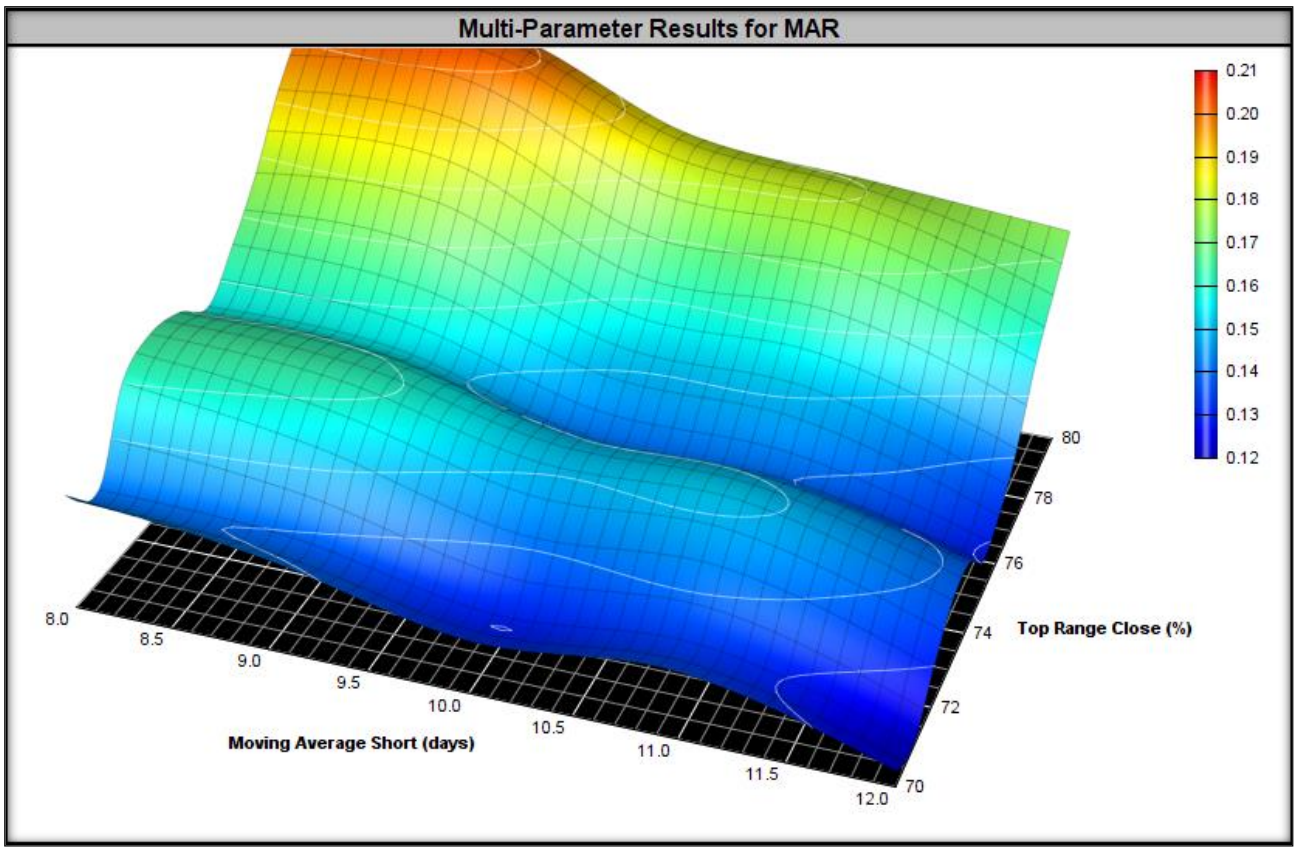

Multi-Parameter Results for MAR
Moving Average Short (days)
Moving Average Long (days)
8.0 8.2 8.4 8.6 8.8 9.0 9.2 9.4 9.6 9.8 10.0 10.2 10.4 10.6 10.8 11.0 11.2 11.4 11.6 11.8 12.0
40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22

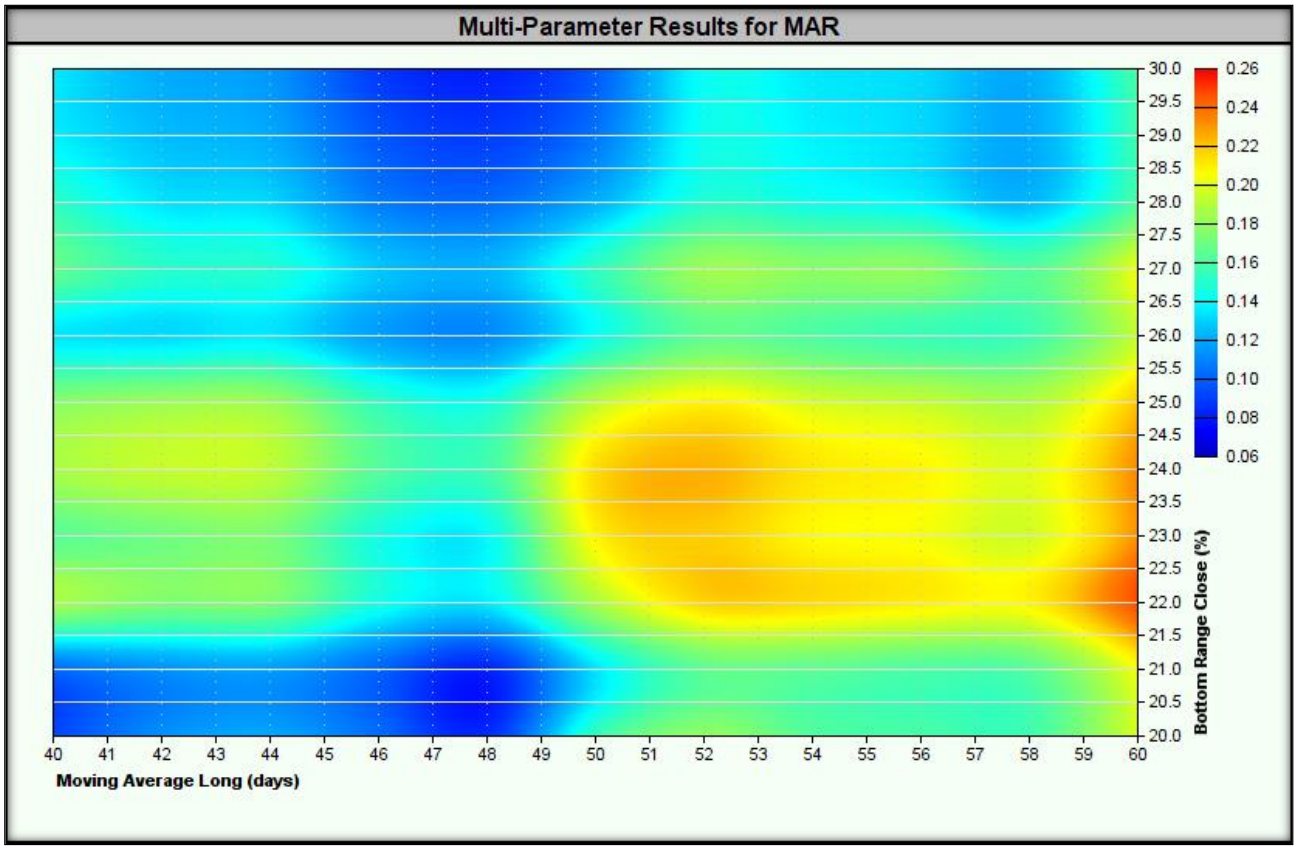

Multi-Parameter Results for MAR
Moving Average Short (days)
Moving Average Long (days)
8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0
40 45 50 55 60
0.09 0.10 0.11 0.12 0.13 0.14 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22

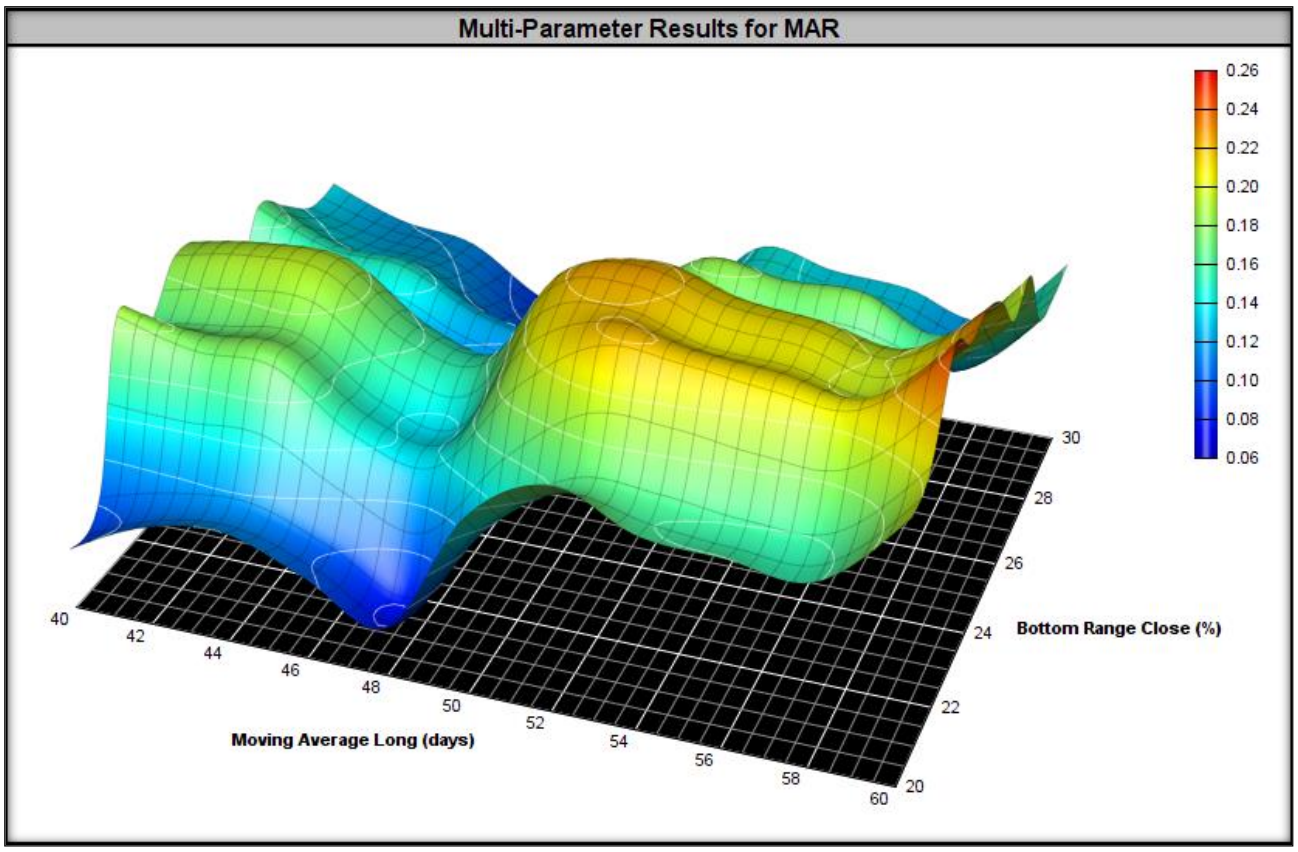

Multi-Parameter Results for MAR
Moving Average Short (days)
Bottom Range Close (%)


Multi-Parameter Results for MAR
Moving Average Short (days)
Bottom Range Close (%)


Multi-Parameter Results for MAR
Moving Average Short (days)
Top Range Close (%)


Multi-Parameter Results for MAR
Moving Average Short (days)
Top Range Close (%)





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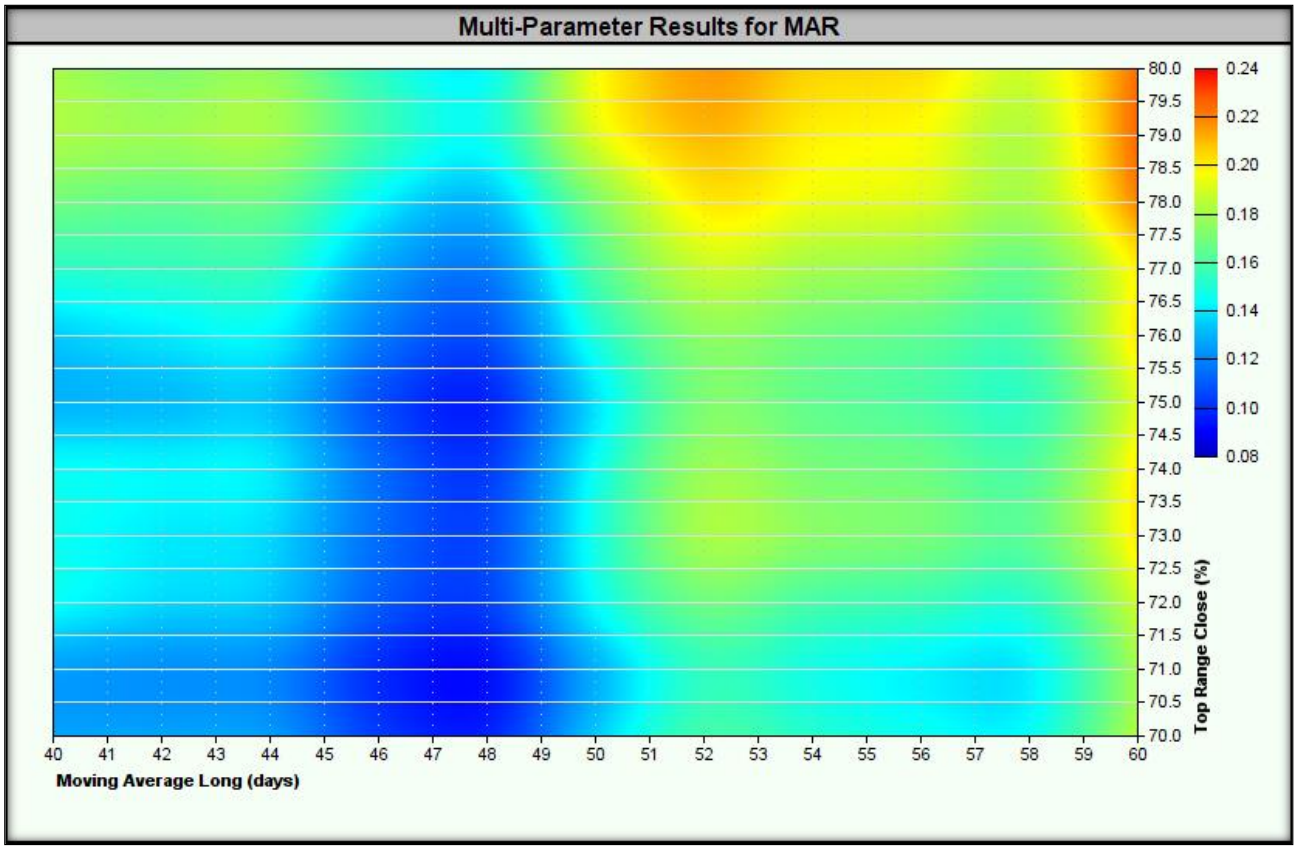
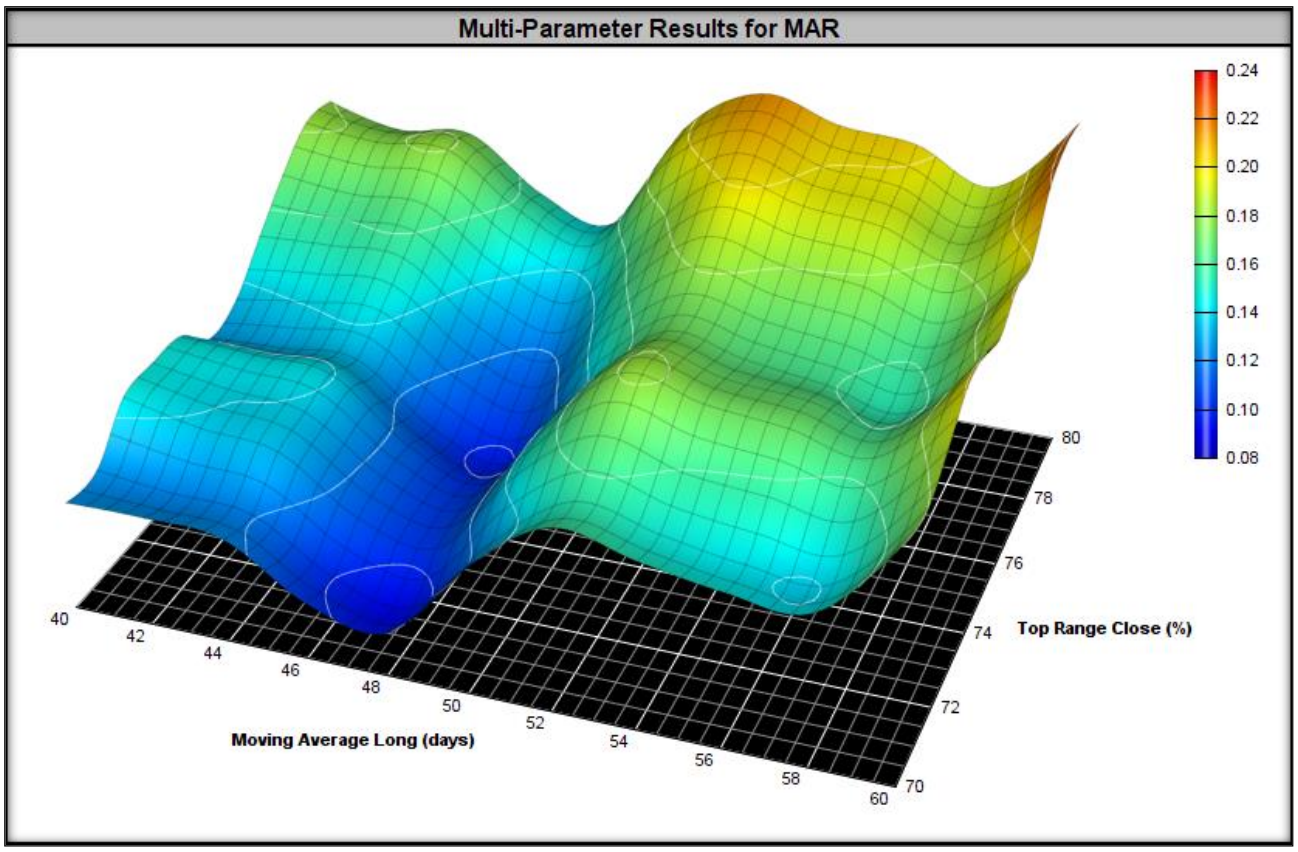
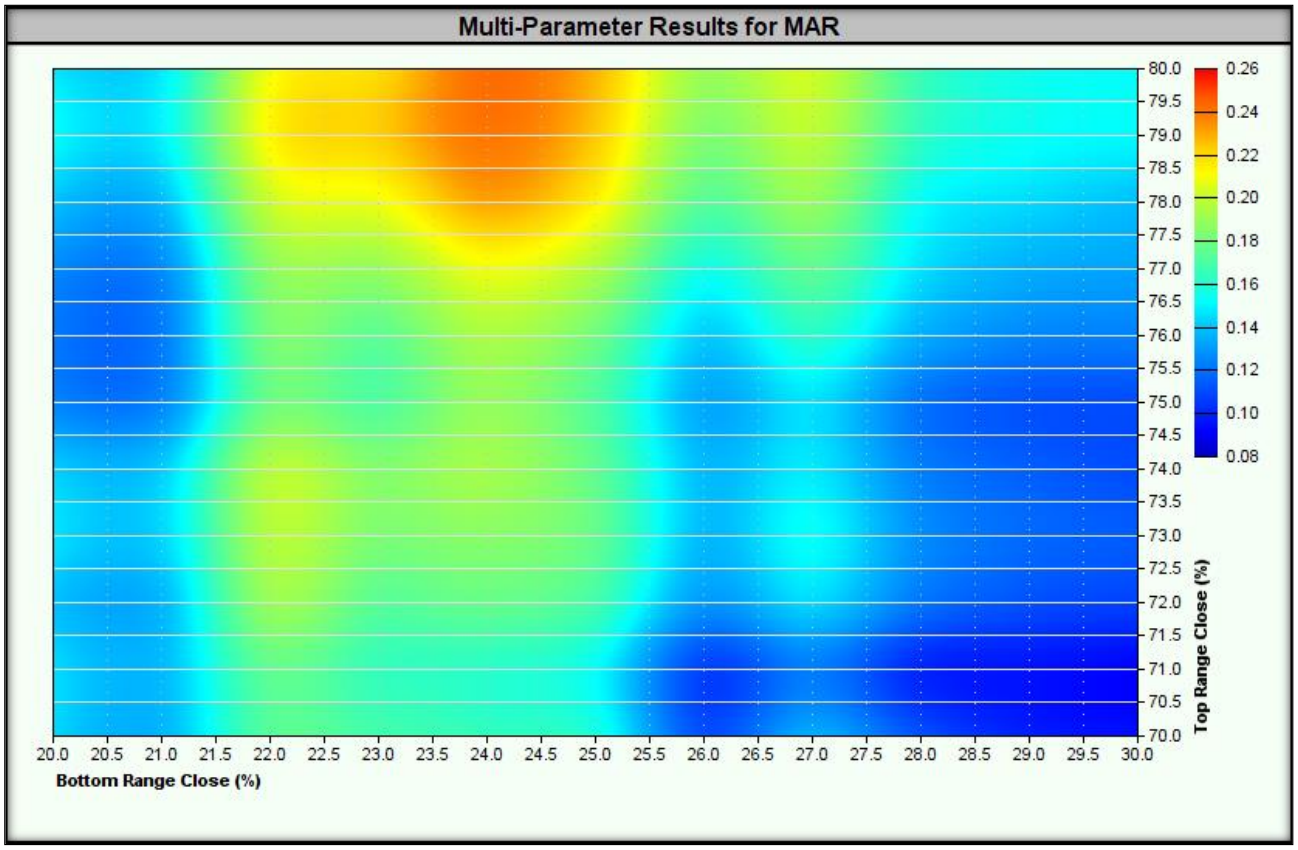
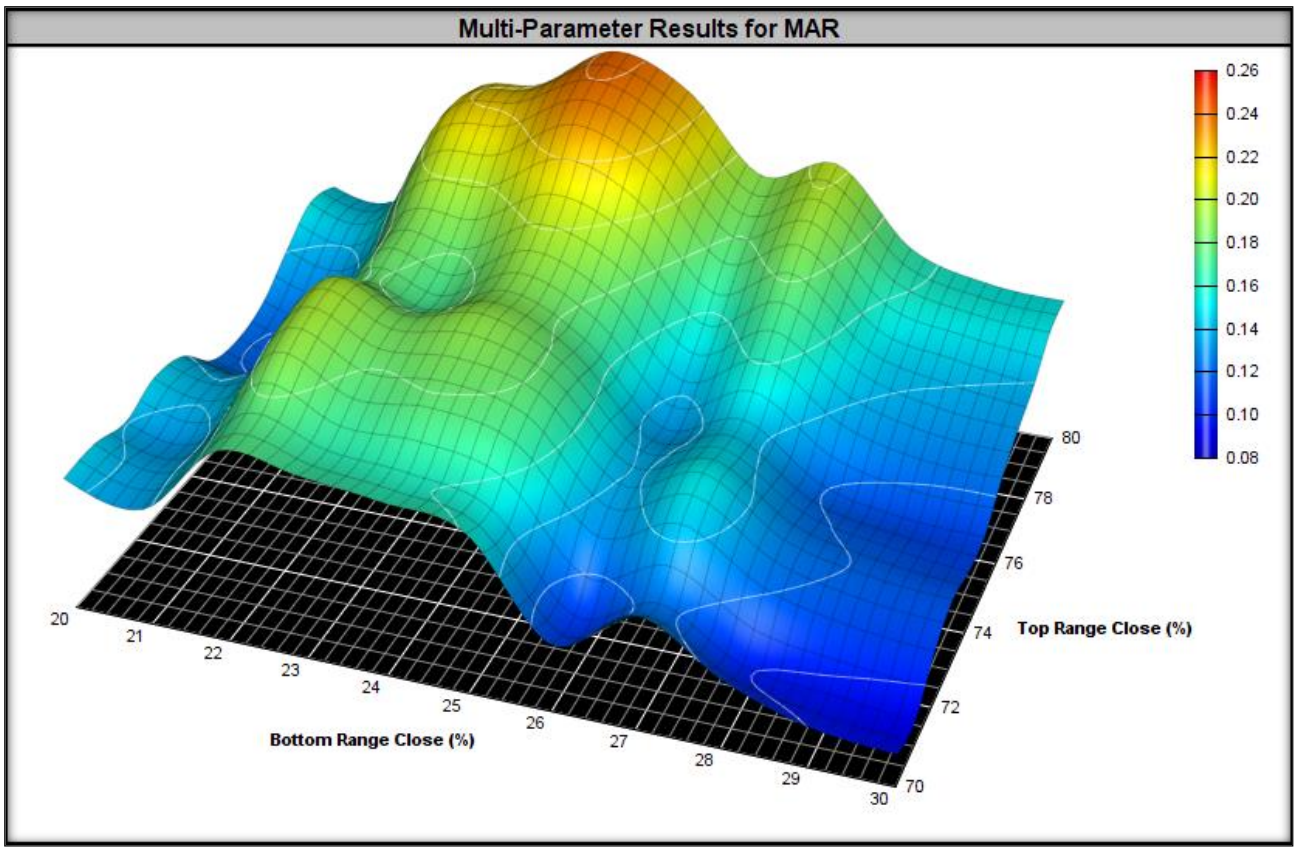
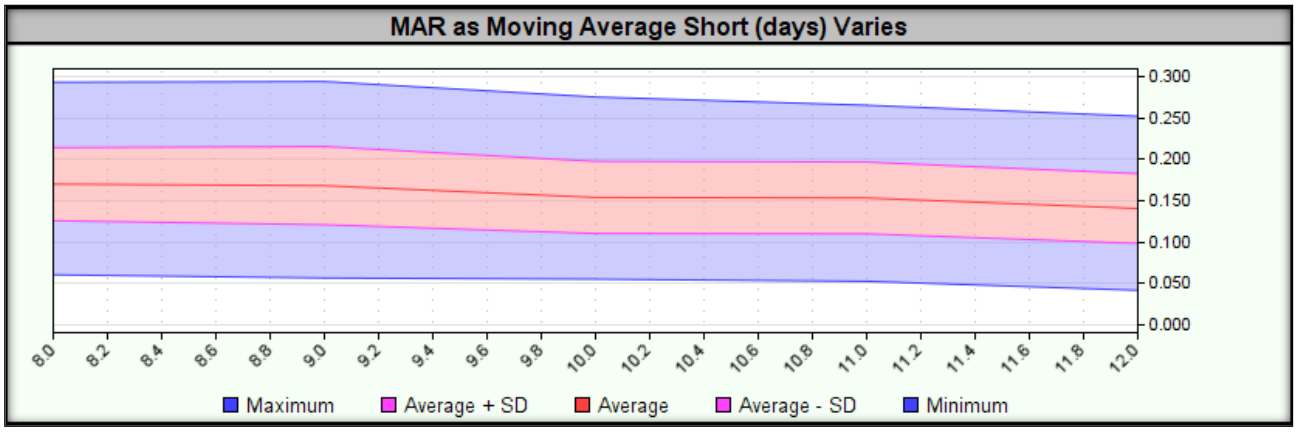
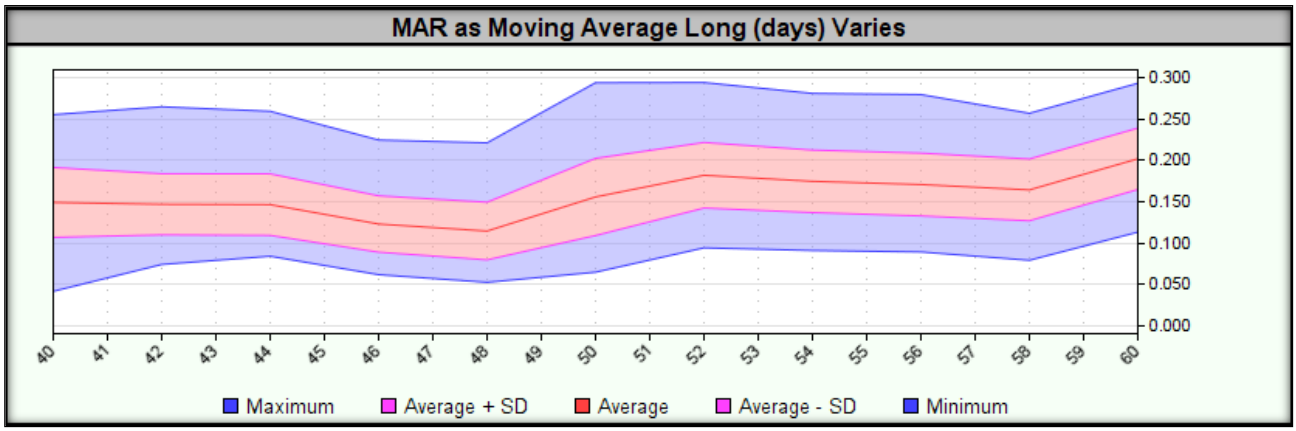

Multi-Parameter Results for MAR
Moving Average Long (days)
Top Range Close (%)

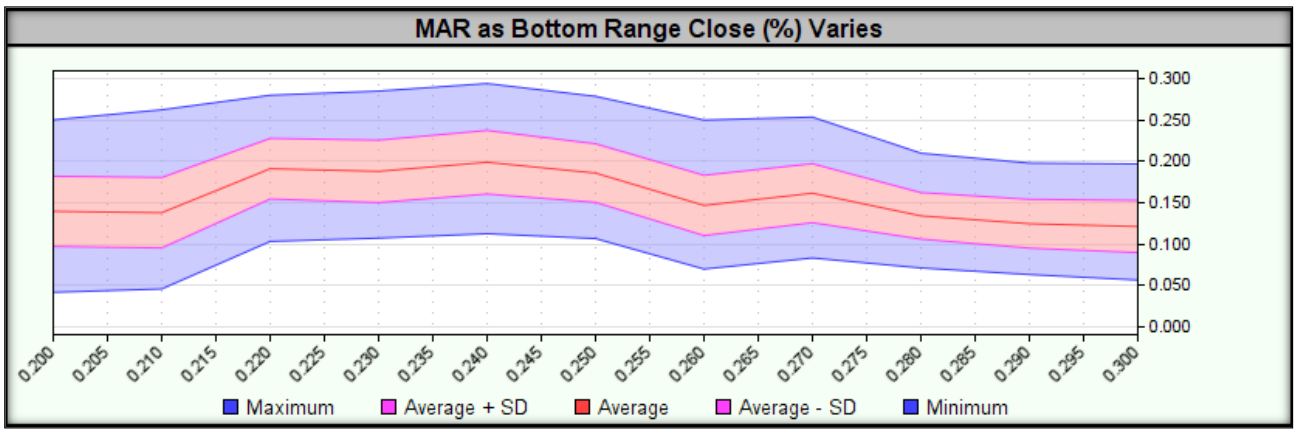

Multi-Parameter Results for MAR
Moving Average Long (days)
Top Range Close (%)

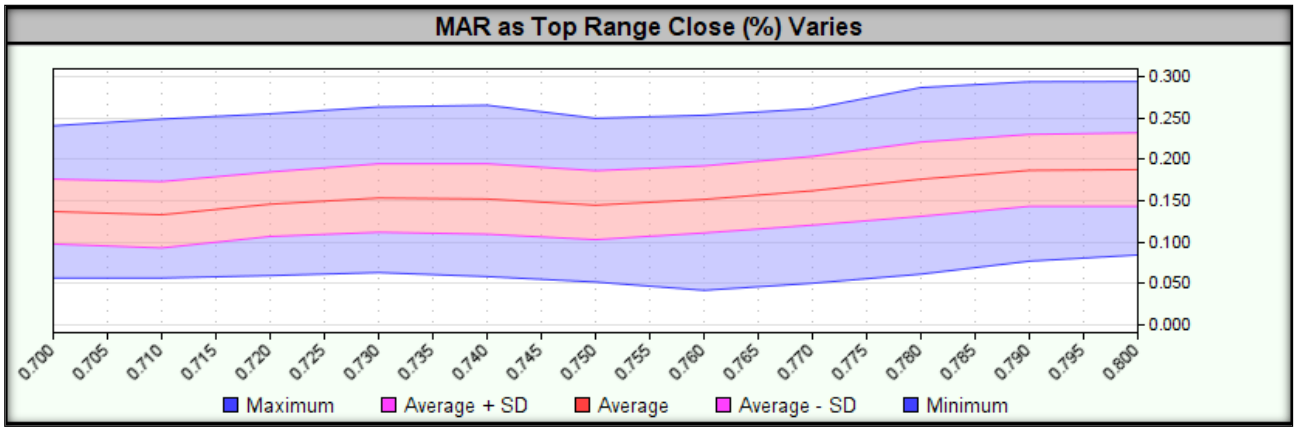

Multi-Parameter Results for MAR
Bottom Range Close (%)
Top Range Close (%)
20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5 30.0
80.0 79.5 79.0 78.5 78.0 77.5 77.0 76.5 76.0 75.5 75.0 74.5 74.0 73.5 73.0 72.5 72.0 71.5 71.0 70.5 70.0
0.26 0.24 0.22 0.20 0.18 0.16 0.14 0.12 0.10 0.08


Multi-Parameter Results for MAR
Bottom Range Close (%)
Top Range Close (%)
20 21 22 23 24 25 26 27 28 29 30
70 72 74 76 78 80
0.26 0.24 0.22 0.20 0.18 0.16 0.14 0.12 0.10 0.08


MAR as Moving Average Short (days) Varies
0.300
0.250
0.200
0.150
0.100
0.050
0.000
8.0 8.2 8.4 8.6 8.8 9.0 9.2 9.4 9.6 9.8 10.0 10.2 10.4 10.6 10.8 11.0 11.2 11.4 11.6 11.8 12.0
Maximum
Average + SD
Average
Average - SD
Minimum


MAR as Moving Average Long (days) Varies
0.300
0.250
0.200
0.150
0.100
0.050
0.000
40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
Maximum
Average + SD
Average
Average - SD
Minimum


MAR as Bottom Range Close (%) Varies
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.200 0.205 0.210 0.215 0.220 0.225 0.230 0.235 0.240 0.245 0.250 0.255 0.260 0.265 0.270 0.275 0.280 0.285 0.290 0.295 0.300
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:

- **Short Moving Average (SMA) Lengths:** Range **8-12 days (step: 1);**
- **Long Moving Average (SMA) Lengths: 40-60 day** range **(step: 2);**
- **Formation candle:**
  - **Lower closing range of the first candle:** range **20%-30% (step: 1 pp.);**
  - **Upper closing range of the second candle:** range **20%-30% (step: 1 pp.).**

The lowest MAR value of -0.09 was achieved for the following parameters:

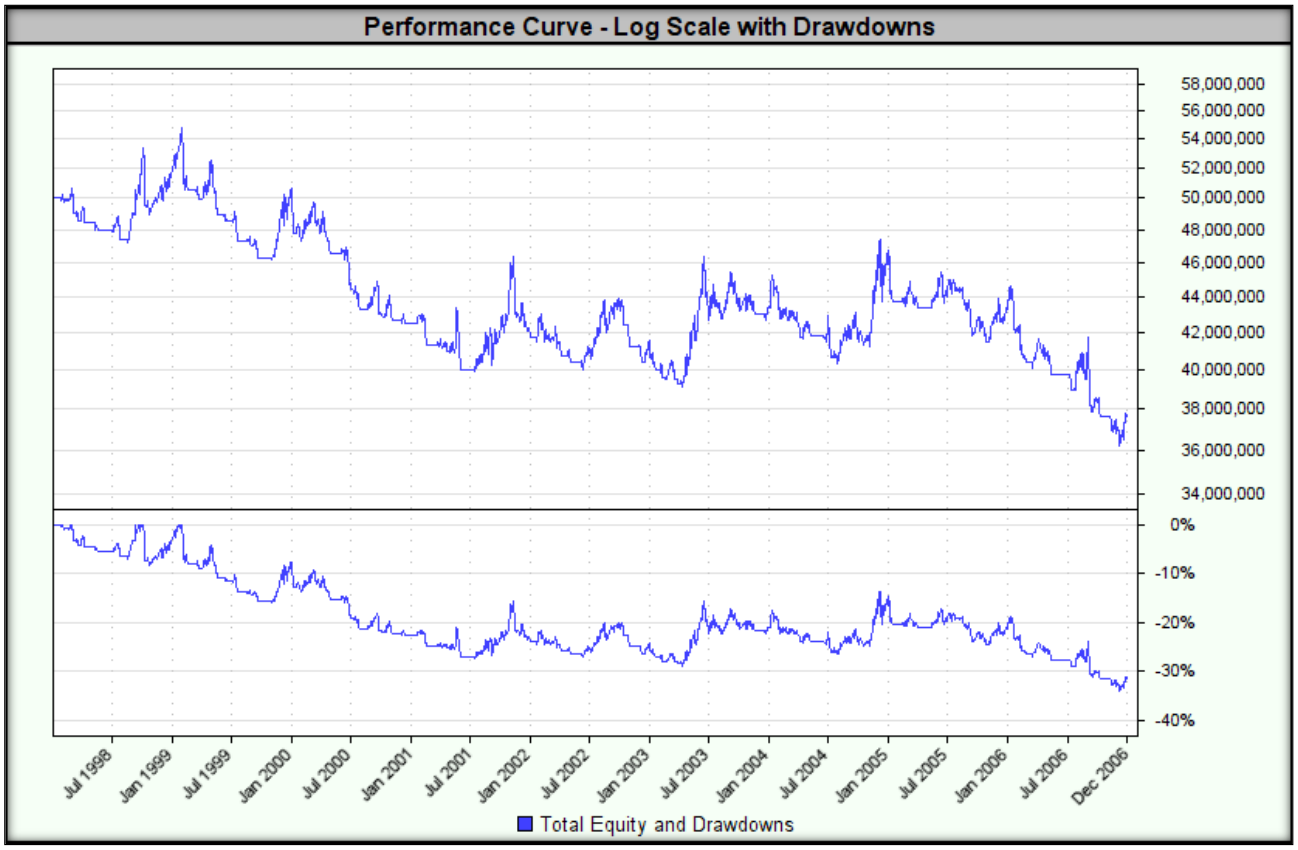
- **Short Moving Average (SMA) Lengths:** 10;
- **Long Moving Average (SMA) Lengths:** 42;
- **Formation candle:**
  - **Lower closing range of the first candle:** 20%;
  - **Upper closing range of the second candle:** 20%.

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 Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD
2794	10	42	20%	80%	$37,596,765.56	-3.12%	-0.09	-0.24	-0.42	34.0%	95.0
2787	10	42	20%	73%	$36,618,579.28	-3.40%	-0.09	-0.28	-0.44	37.2%	95.0
2666	10	40	20%	73%	$37,139,133.73	-3.25%	-0.09	-0.26	-0.42	36.3%	95.0
2788	10	42	20%	74%	$37,382,829.52	-3.18%	-0.09	-0.26	-0.40	35.7%	91.9
2793	10	42	20%	79%	$37,541,525.51	-3.14%	-0.09	-0.25	-0.43	35.7%	95.0
2673	10	40	20%	80%	$38,426,684.57	-2.89%	-0.09	-0.22	-0.39	32.9%	95.0
2667	10	40	20%	74%	$37,907,343.07	-3.03%	-0.09	-0.24	-0.39	34.8%	91.9
2672	10	40	20%	79%	$38,046,571.77	-2.99%	-0.09	-0.24	-0.41	34.8%	95.0
2789	10	42	20%	75%	$38,278,904.22	-2.93%	-0.09	-0.24	-0.36	34.2%	91.9
3029	10	46	20%	73%	$39,451,167.92	-2.60%	-0.08	-0.19	-0.33	30.8%	95.0

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 0.58 was achieved for the following parameters:

- **Short Moving Average (SMA) Lengths:** 8;
- **Long Moving Average (SMA) Lengths:** 60;
- **Formation candle:**
  - **Lower closing range of the first candle:** 30%;
  - **Upper closing range of the second candle:** 23%.

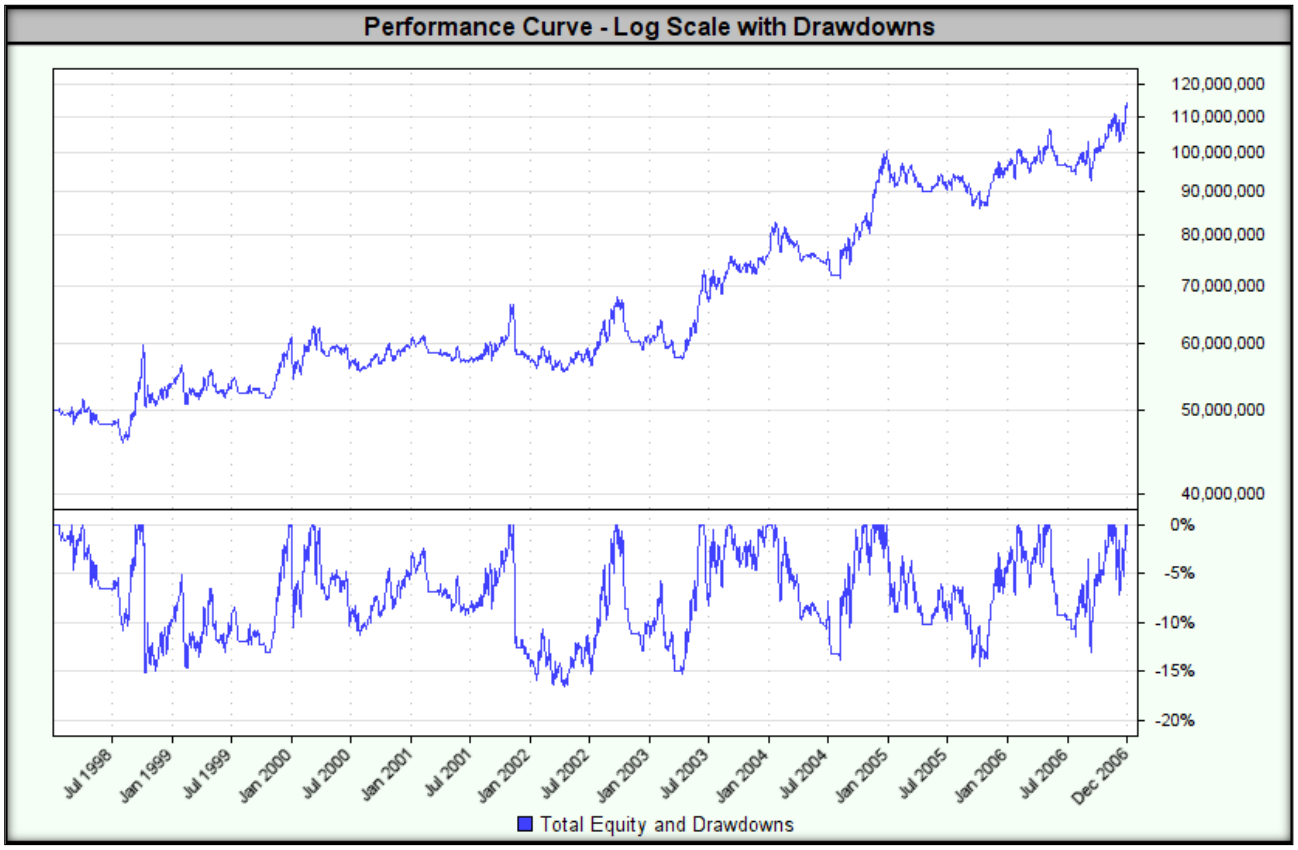
The highest MAR value was accompanied by **a drawdown of 16.4%.**

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 Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD
1328	8	60	30%	77%	$112,938,700.41	9.49%	0.58	0.69	0.87	16.4%	19.6
1326	8	60	30%	75%	$112,011,669.82	9.39%	0.57	0.69	0.89	16.4%	19.7
1329	8	60	30%	78%	$110,991,806.20	9.27%	0.56	0.67	0.84	16.5%	19.6
1327	8	60	30%	76%	$109,596,749.31	9.12%	0.55	0.67	0.85	16.4%	19.7
1323	8	60	30%	72%	$107,928,912.89	8.93%	0.51	0.64	0.77	17.4%	19.7
1330	8	60	30%	79%	$104,692,726.43	8.57%	0.51	0.63	0.76	16.7%	36.9
1325	8	60	30%	74%	$106,982,076.16	8.83%	0.51	0.65	0.85	17.4%	19.7
1322	8	60	30%	71%	$105,324,419.83	8.64%	0.50	0.62	0.75	17.4%	19.7
1321	8	60	30%	70%	$104,081,690.27	8.50%	0.49	0.61	0.72	17.5%	19.7
1207	8	58	30%	77%	$97,045,358.20	7.65%	0.48	0.58	0.64	15.9%	22.2

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 37.6%.**

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 Range Close (%)	Top Range Close (%)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max ...	Longest DD
6029	12	50	29%	70%	$61,186,449.37	2.27%	0.06	0.23	0.24	37.6%	85.6
6007	12	50	27%	70%	$59,980,744.14	2.04%	0.05	0.21	0.21	37.5%	98.7
683	8	50	27%	70%	$61,656,268.67	2.36%	0.06	0.23	0.23	37.5%	97.0
6040	12	50	30%	70%	$64,782,450.02	2.92%	0.08	0.27	0.28	37.4%	74.0
2787	10	42	20%	73%	$36,618,579.28	-3.40%	-0.09	-0.28	-0.44	37.2%	95.0
6018	12	50	28%	70%	$64,175,599.35	2.81%	0.08	0.26	0.30	36.9%	85.2
694	8	50	28%	70%	$65,958,709.26	3.13%	0.08	0.29	0.31	36.8%	74.7
705	8	50	29%	70%	$64,227,977.74	2.82%	0.08	0.27	0.28	36.8%	85.4
2666	10	40	20%	73%	$37,139,133.73	-3.25%	-0.09	-0.26	-0.42	36.3%	95.0
3345	10	50	27%	70%	$58,811,847.16	1.82%	0.05	0.20	0.19	36.2%	80.1

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

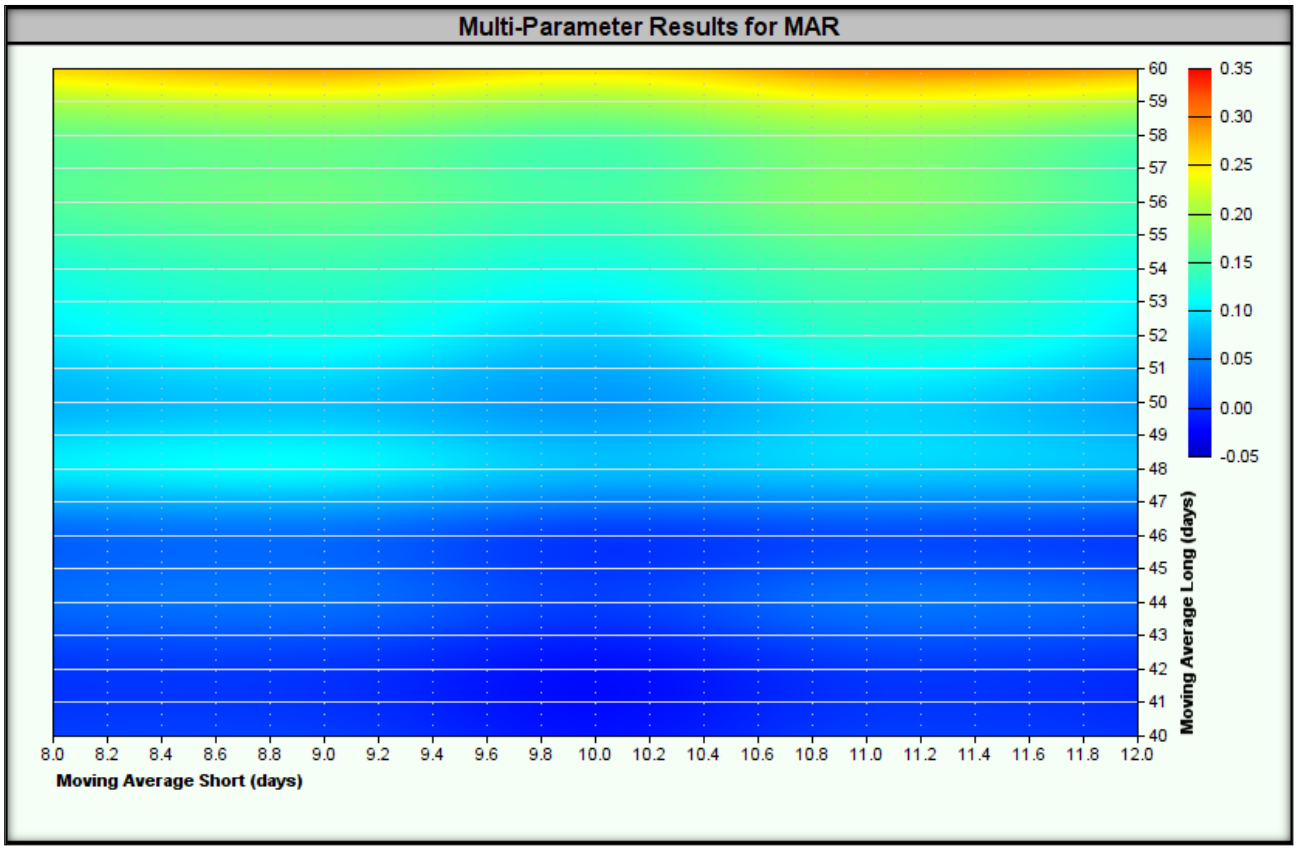
- **MAR value** – which indicates low stability of the strategy in various market conditions.

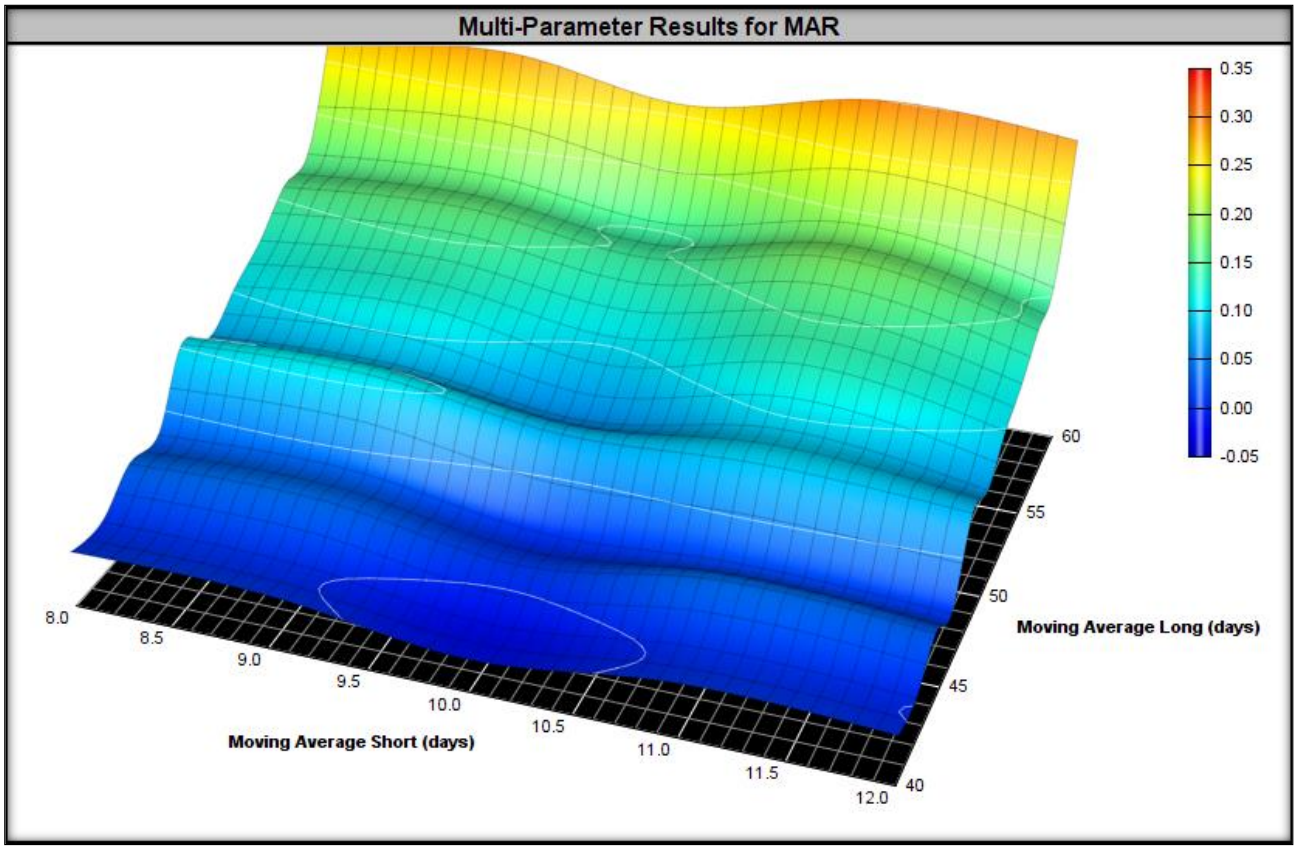
Therefore, **<u>further testing of the strategy on these ranges is not justified,</u>** because its use in real transactions **is highly doubtful.** Nevertheless, based on the results obtained (**heatmaps for tested ranges)** and the behavior of the strategy, we can create another version, in which we will include:

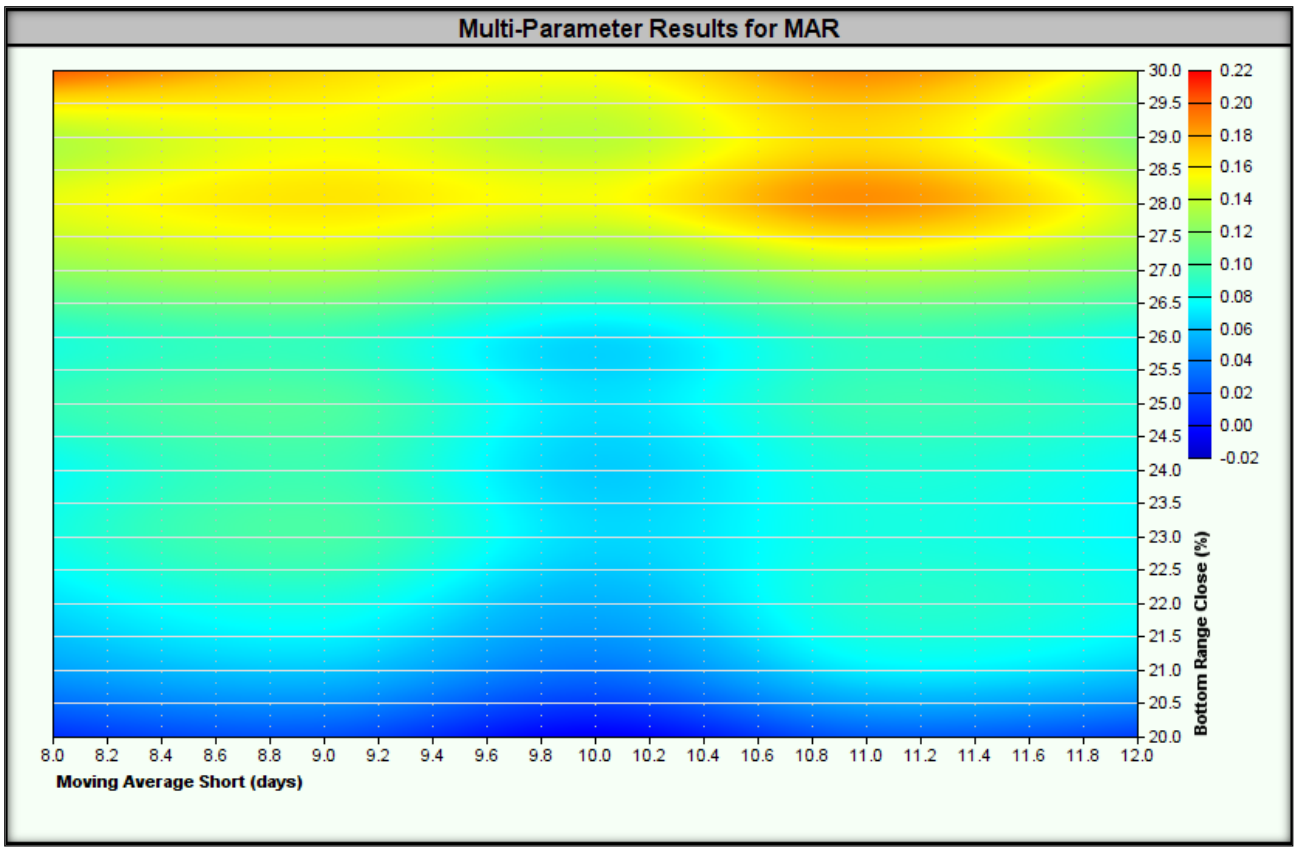
- **One common parameter for the lower and upper closing range of the candle** – this will reduce the number of parameters from 4 to 3, which should improve the stability of the strategy.
- **Long Moving Average (SMA) Optimization –** Heatmaps indicate that better results can be achieved when the long SMA is above 60.

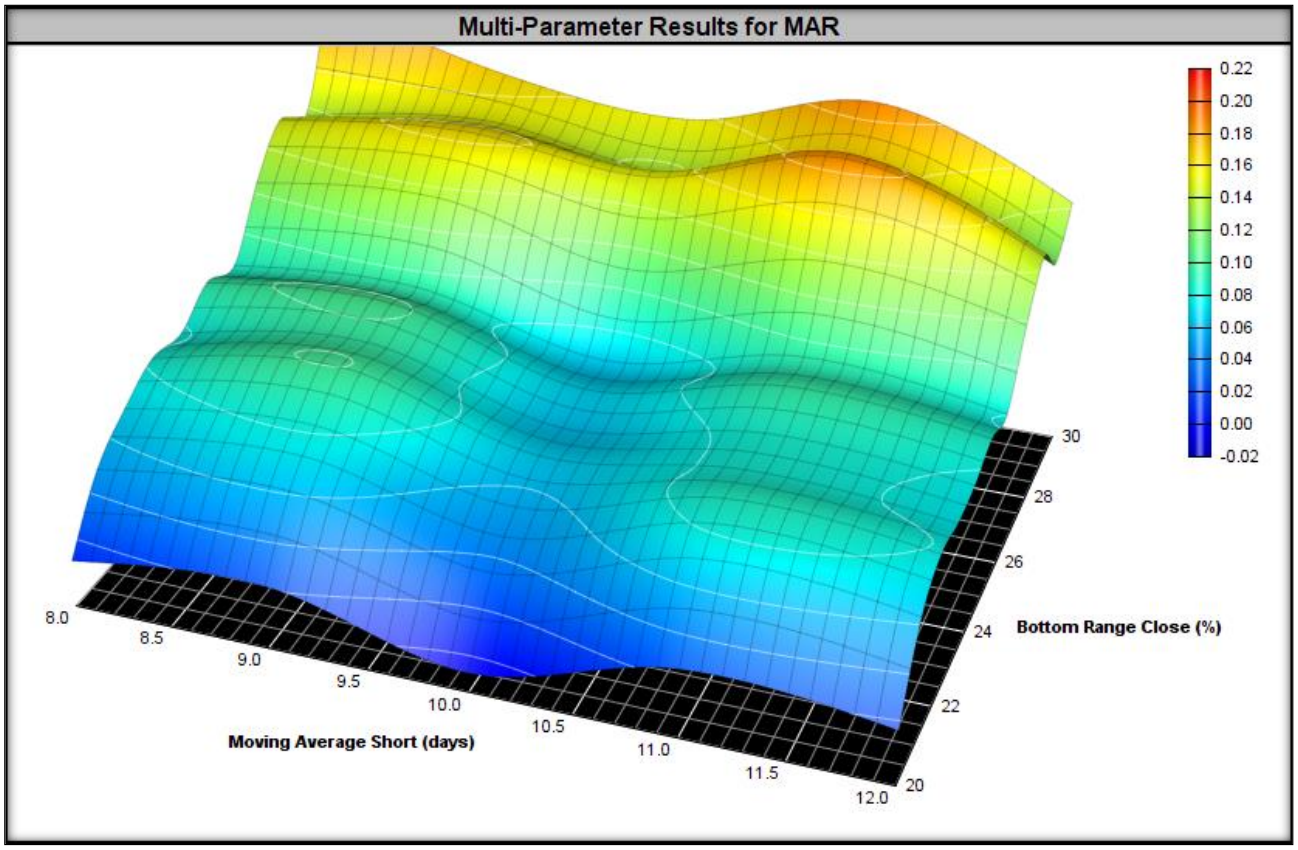
- **Adding the remaining futures contracts to the instrument portfolio –** increasing the portfolio of tested instruments may improve the stability of the strategy.

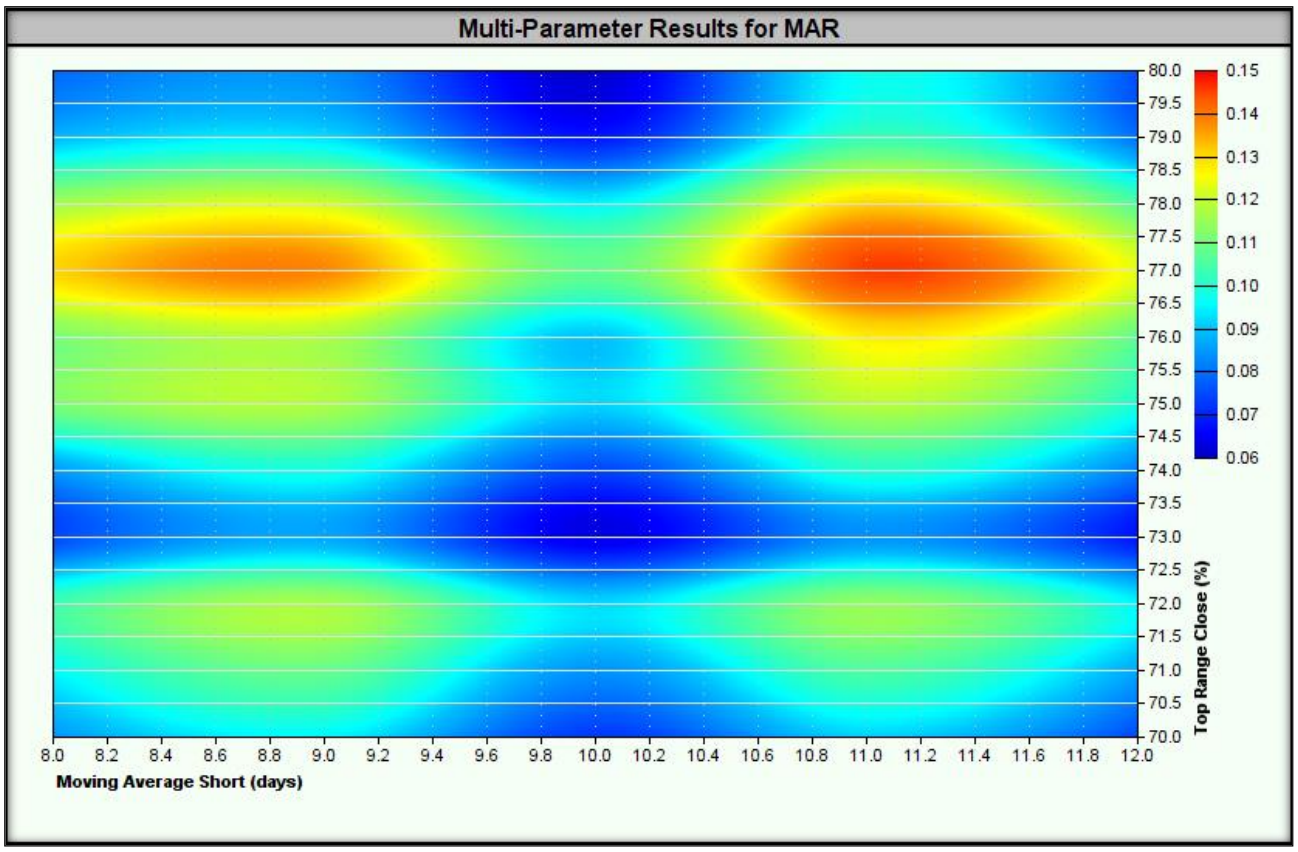
Heatmaps for the tested ranges are presented below.

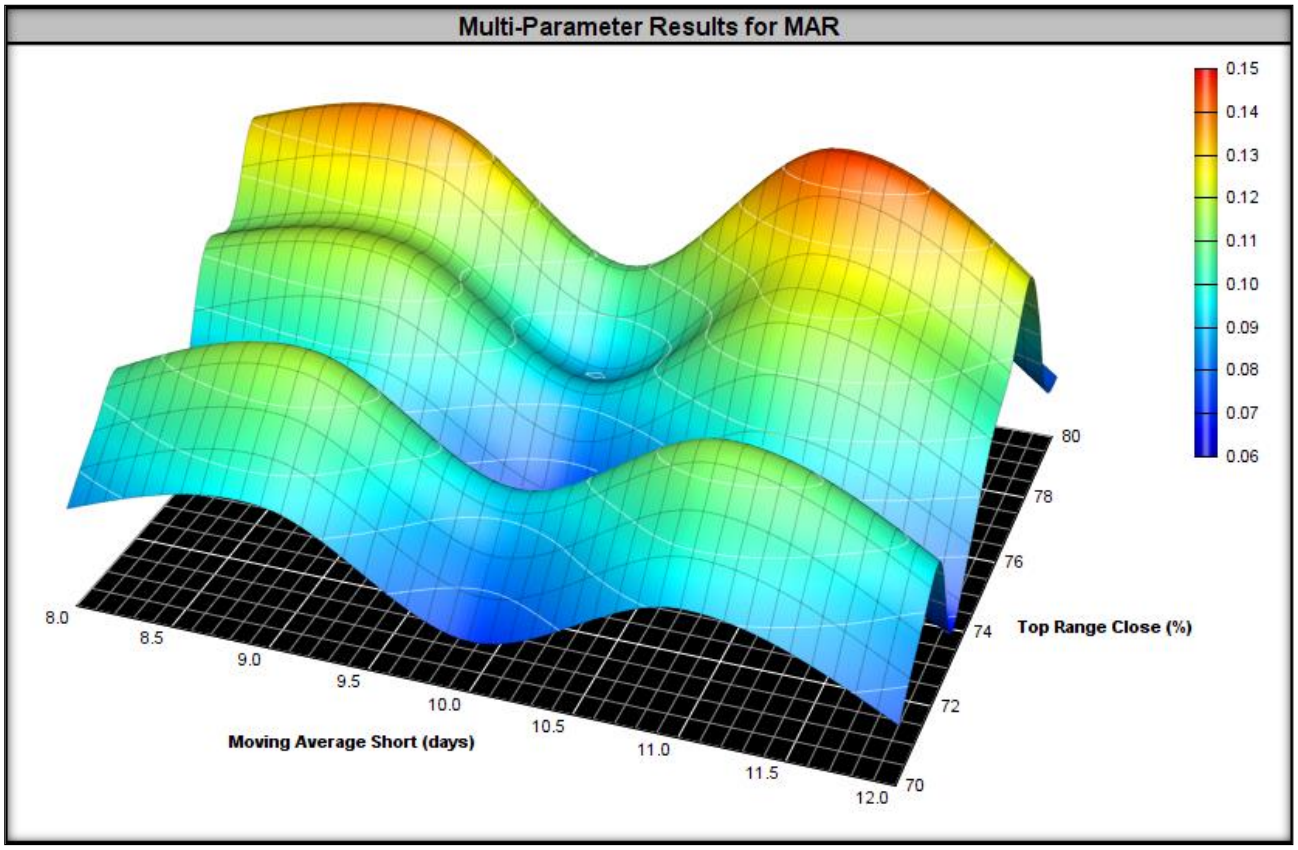


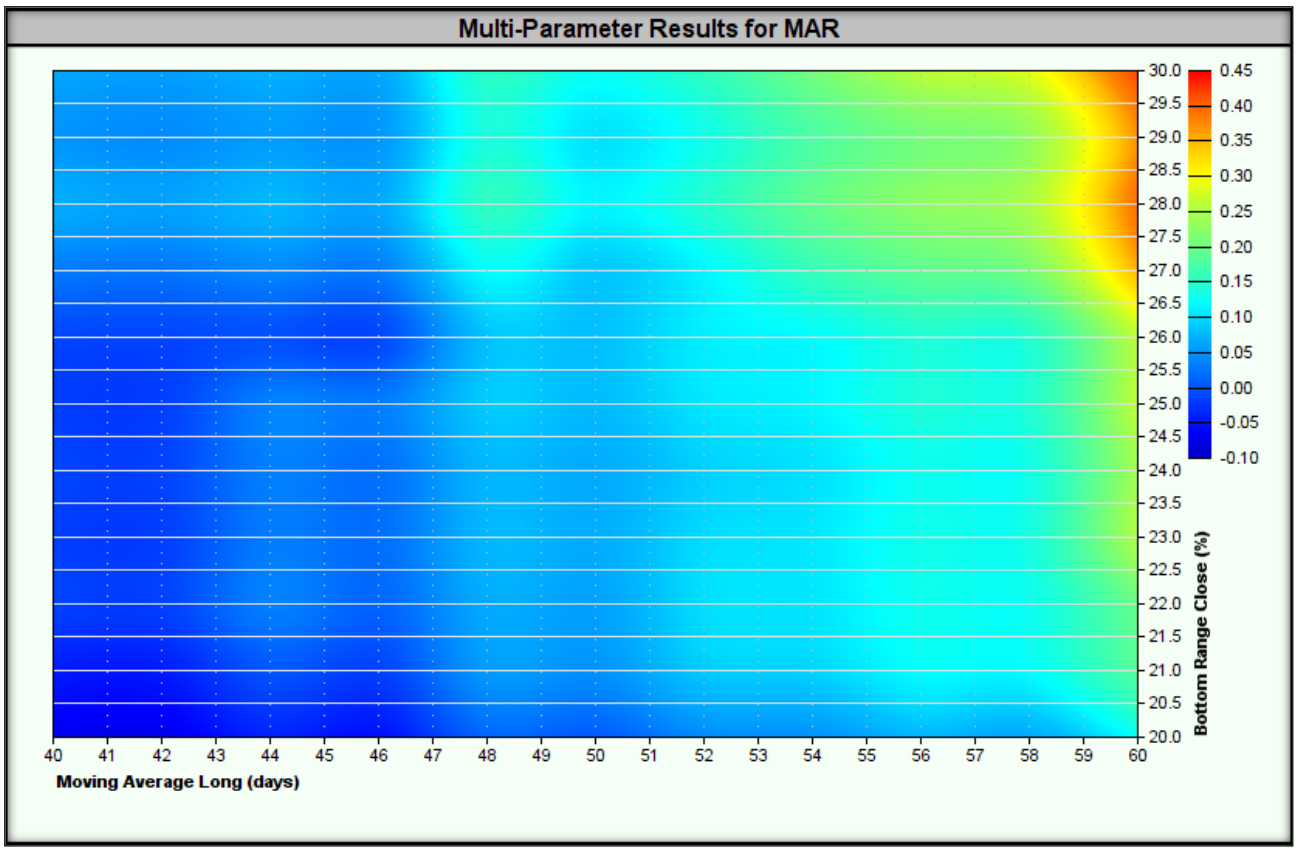

Multi-Parameter Results for MAR
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Moving Average Short (days)
40
45
50
55
60
Moving Average Long (days)

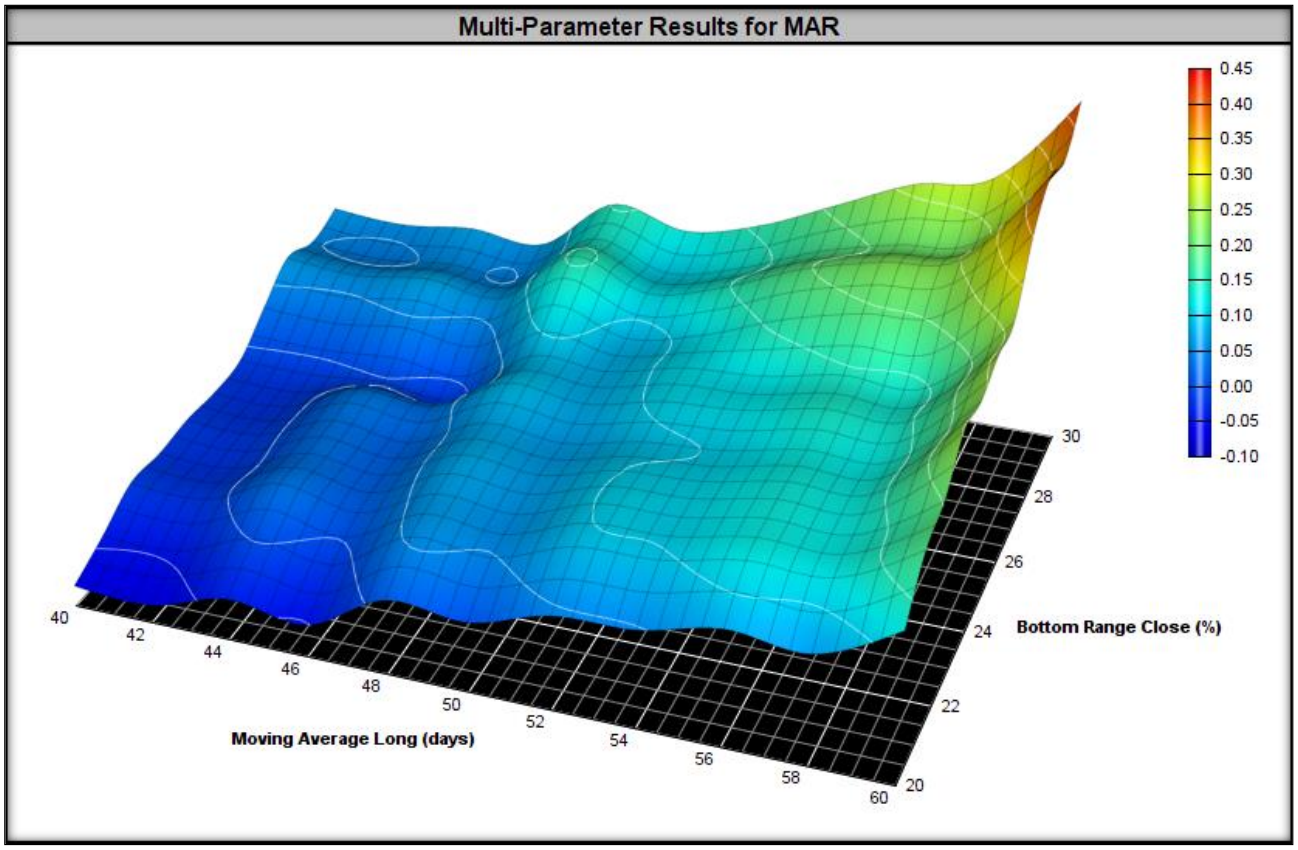

Multi-Parameter Results for MAR
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
Bottom Range Close (%)
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8
10.0
10.2
10.4
10.6
10.8
11.0
11.2
11.4
11.6
11.8
12.0
Moving Average Short (days)

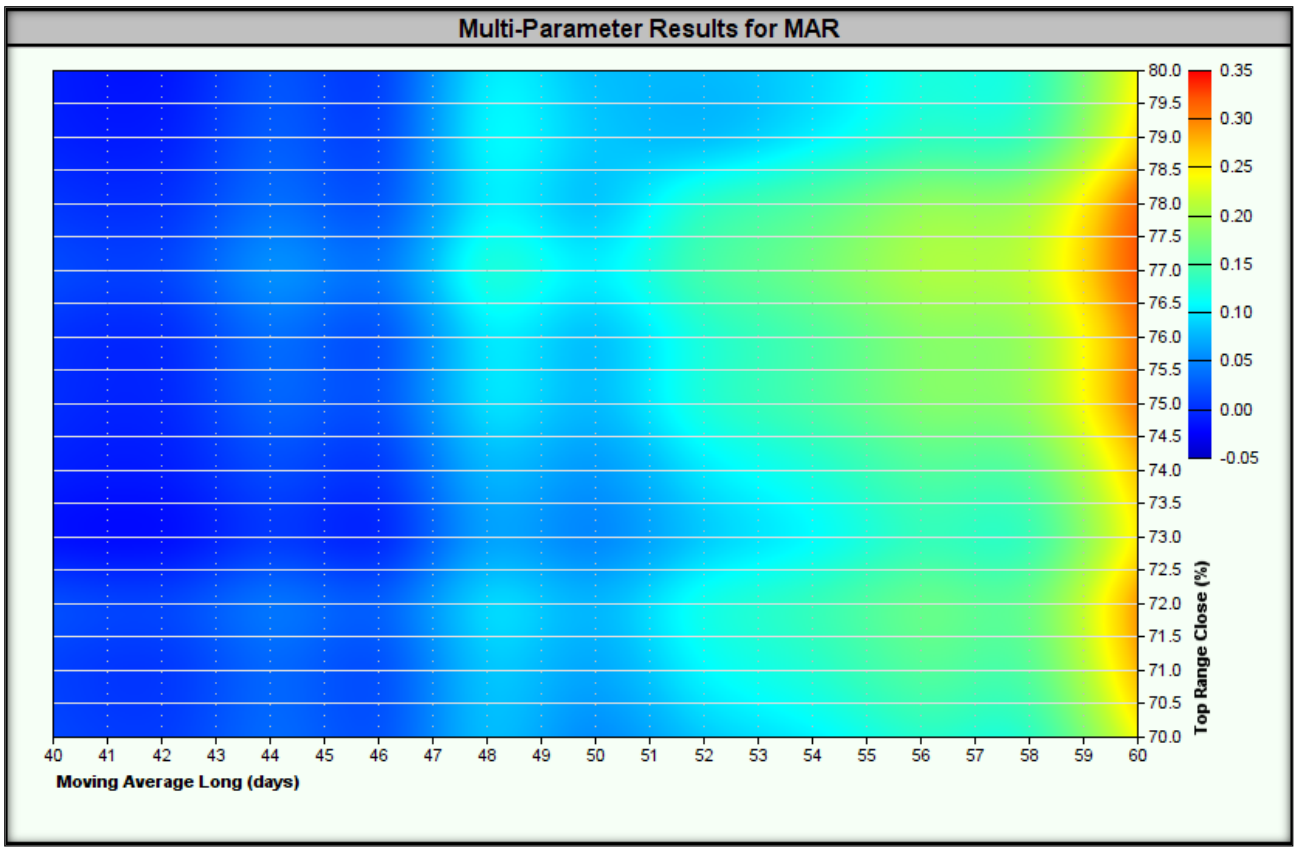

Multi-Parameter Results for MAR
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Moving Average Short (days)
30
28
26
24
22
20
Bottom Range Close (%)

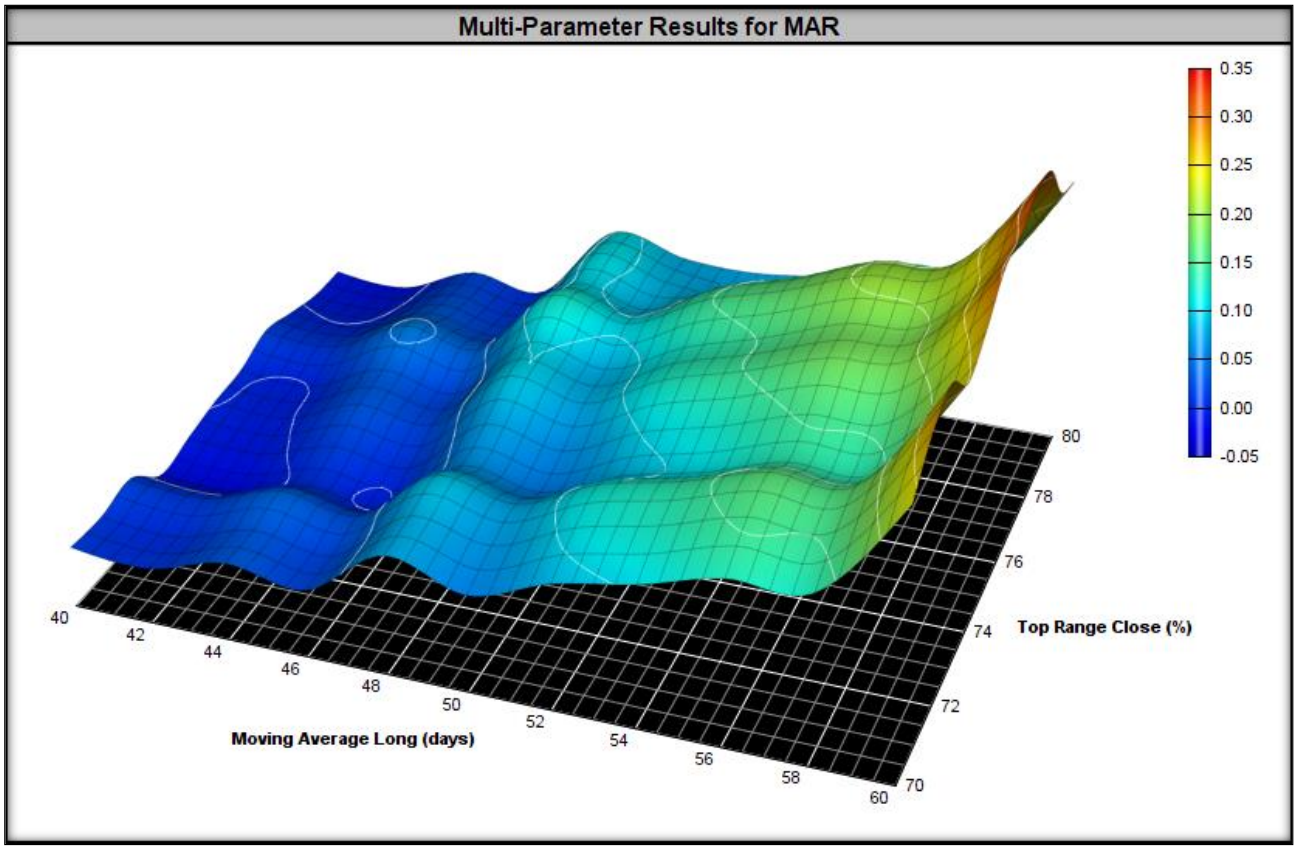

Multi-Parameter Results for MAR
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
74.0
73.5
73.0
72.5
72.0
71.5
71.0
70.5
70.0
Top Range Close (%)
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8
10.0
10.2
10.4
10.6
10.8
11.0
11.2
11.4
11.6
11.8
12.0
Moving Average Short (days)

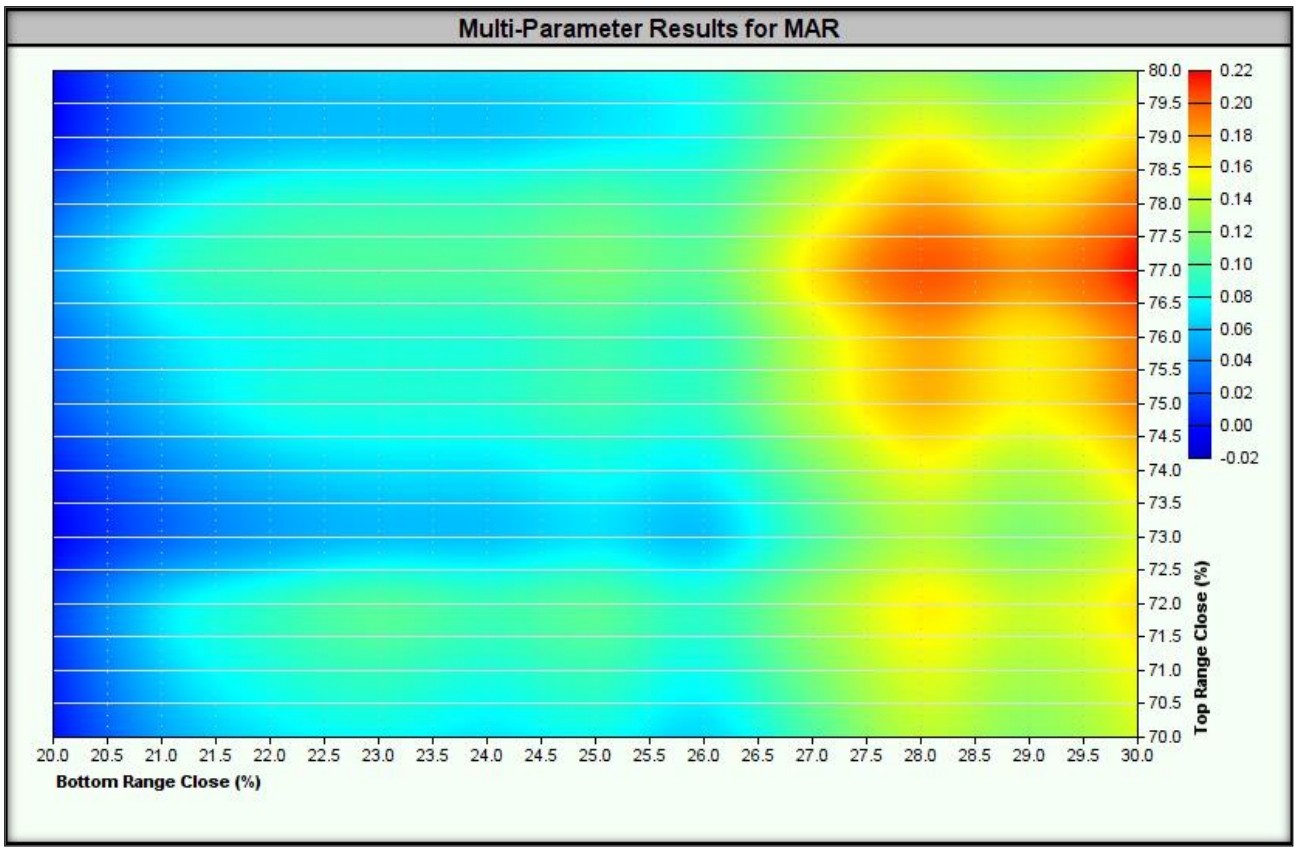

Multi-Parameter Results for MAR
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
8.0
8.5
9.0
9.5
10.0
10.5
11.0
11.5
12.0
Moving Average Short (days)
70
72
74
76
78
80
Top Range Close (%)

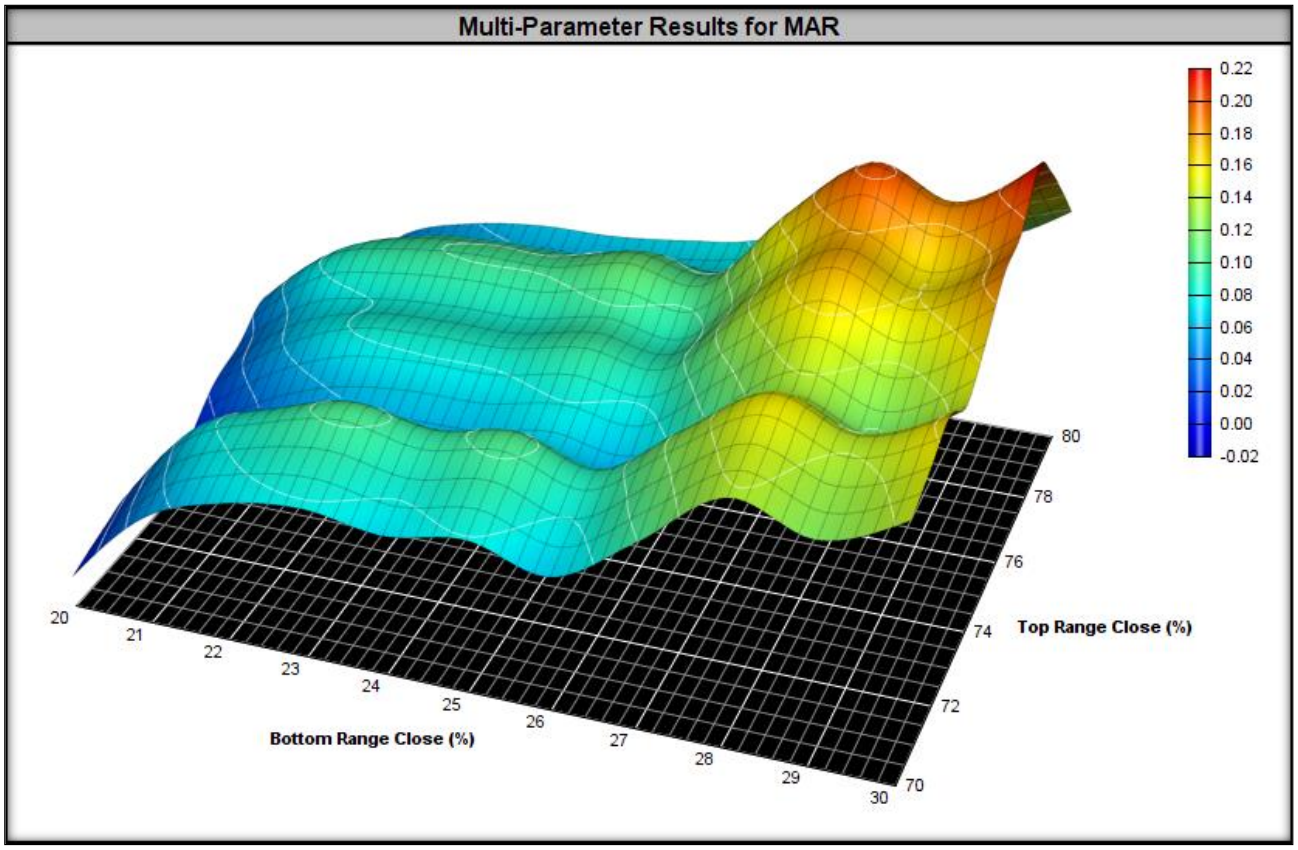

Multi-Parameter Results for MAR
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
Bottom Range Close (%)
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Moving Average Long (days)

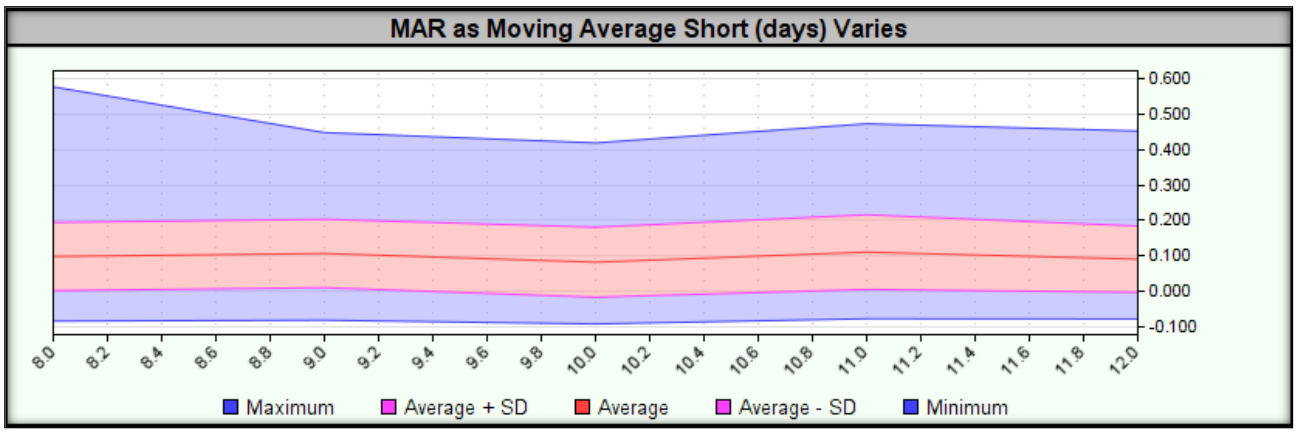

Multi-Parameter Results for MAR
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
40
42
44
46
48
50
52
54
56
58
60
Moving Average Long (days)
30
28
26
24
22
20
Bottom Range Close (%)

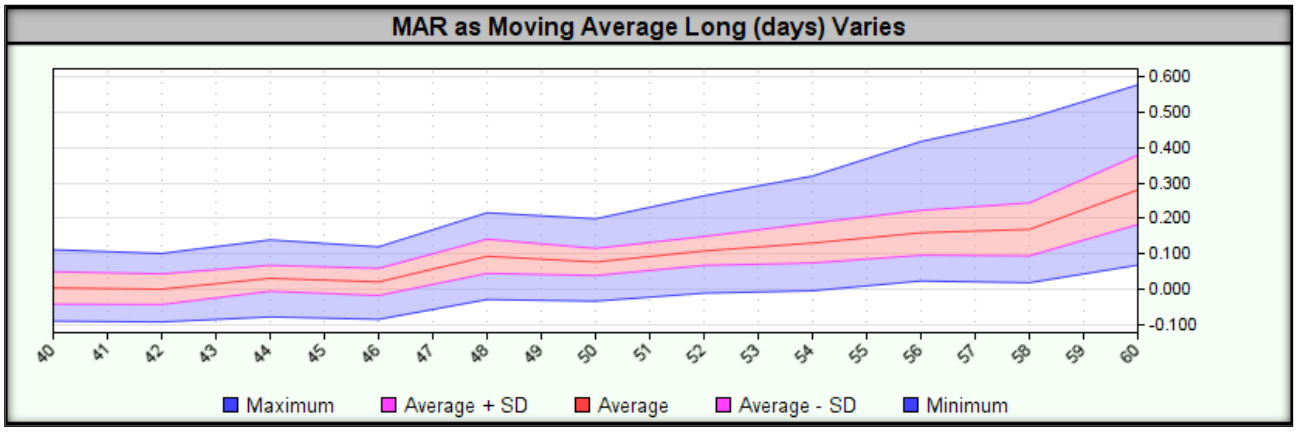

Multi-Parameter Results for MAR
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
74.0
73.5
73.0
72.5
72.0
71.5
71.0
70.5
70.0
Top Range Close (%)
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
Moving Average Long (days)

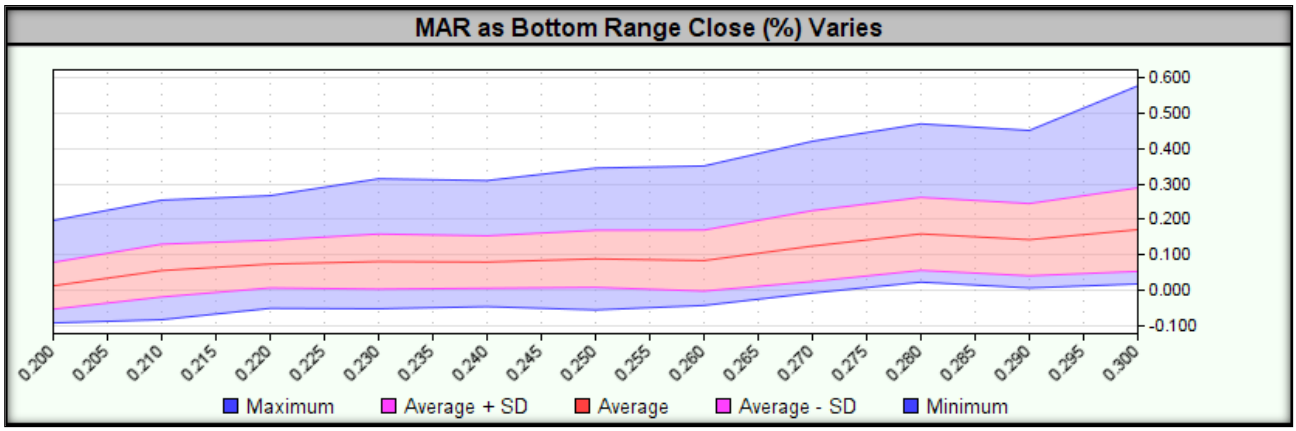

Multi-Parameter Results for MAR
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
40
42
44
46
48
50
52
54
56
58
60
Moving Average Long (days)
70
72
74
76
78
80
Top Range Close (%)

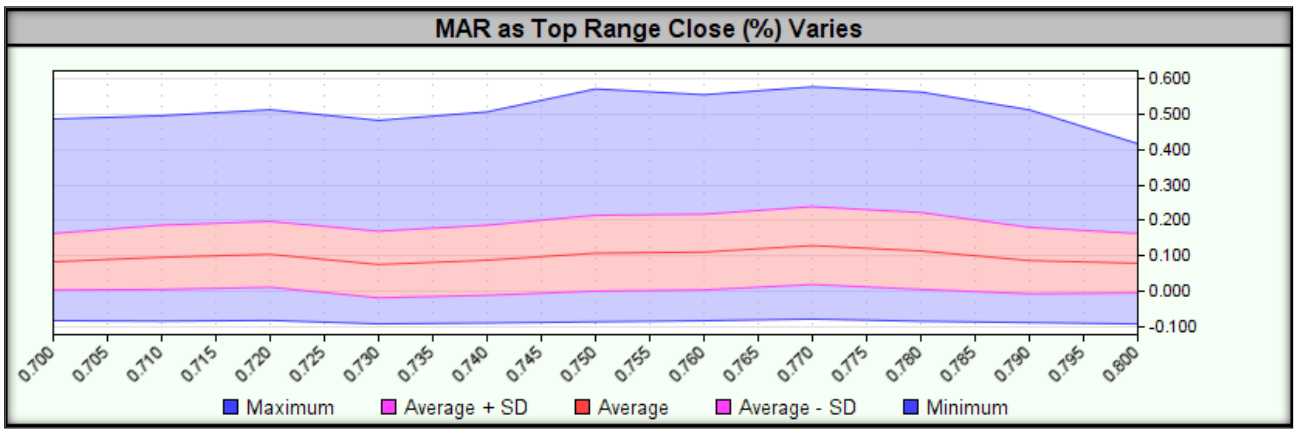

Multi-Parameter Results for MAR
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
75.5
75.0
74.5
74.0
73.5
73.0
72.5
72.0
71.5
71.0
70.5
70.0
Top Range Close (%)
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
Bottom Range Close (%)


Multi-Parameter Results for MAR
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
20
21
22
23
24
25
26
27
28
29
30
Bottom Range Close (%)
70
72
74
76
78
80
Top Range Close (%)


MAR as Moving Average Short (days) Varies
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
8.0
8.2
8.4
8.6
8.8
9.0
9.2
9.4
9.6
9.8
10.0
10.2
10.4
10.6
10.8
11.0
11.2
11.4
11.6
11.8
12.0
Maximum
Average + SD
Average
Average - SD
Minimum







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

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.**