Spent Market Trading Pattern v.2

Investment Strategy Testing Summary

Spent Market Trading Pattern (SMTP) v.2 strategy is **a modification of version v.1,** inspired by Larry Connors' approach. Version **v.2** retains the same key parameters as v.1, but **adds a directional filter based on the moving average** and **changes the exit logic:** instead of a time-exit and a defensive stop loss order, the position is **closed at the opening of the next session after a new extreme** is established in the direction of the transaction (for a long position: new local highs). As a result, the strategy is more **selective,** but also riskier, and has a clear **price** exit condition.

It's worth noting that while the strategy's results on in-sample data are decent, it failed stability testing across a wide range of optimized parameters. This means the strategy loses its profitability and generates significantly larger drawdowns when tested with suboptimal parameters. Therefore, **it is not recommended for use in real-world trading.**

Our goal is to have a strategy that remains **profitable and effective across a wide range of parameters,** because the market is a volatile organism, and optimal parameters can change over time. **I can't** emphasize enough that for **a strategy to work** in real-world conditions, it must also perform under **suboptimal parameters** and **conditions.** In short, **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly capture 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

The Spent Market Trading Pattern (SMTP) v.2 strategy is a modification of version v.1 that **adds a directional filter based on the moving average** and **changes the exit logic.** The system looks for a day with "exhausted movement" characteristics, but only if it aligns with **the prevailing uptrend.** For **a long position,** the signal candle must: (1) establish **a periodic low,** (2) have **the widest daily range** compared to **the last few sessions,** (3) **close at the top of its own range,** and (4) **close above the long-term moving average.** Entry is executed **with a buy stop order 1 tick above** the signal candle's high without **a stop loss order;** the opening order is active only in the next session and is activated only when the market confirms the breakout. After activating the opening order, the position **is closed at the open of the day following the establishment of a new local high.**

The strategy uses:

- **"Exhaustion" filter** – a combination of Y-day low/high, the largest X-day range, and a close position within Q% of the daily range;
- **Trend Filter** – trades only in line with the dominant trend based on the moving average;
- **Precise trigger** – buy stop relative to the signal candle;
- **Exiting a position** – closing the position at new local highs (without time-exit).

Characteristics of the strategy and its strengths and weaknesses:

- **Minimalistic, easy to program** – a few simple rules ensure transparency and low computational costs;
- **Higher quality signal** – requires four conditions to be met simultaneously before entering the market;
- **Selectivity at the expense of frequency** – strict filters result in fewer trades, but usually a better risk/reward profile;
- **Lack of stop loss increases the risk of drawdowns and gaps** – strict control of position size is necessary;
- **No trailing lead position** – short, "impulsive" holding of the position to a new local high, without trying to "catch the whole trend".

Spent Market Trading Pattern (SMTP) v.2, while simple, provides **a solid foundation for building algorithmic portfolios.** However, it requires **discipline and strict adherence to risk management methods.**

Step 2: Determine investment principles

Below is **the pseudocode** for the **Spent Market Trading Pattern (SMTP) v.2 strategy** on daily data:

1. **Calculating Indicators:**
    a. **Y-DayLowestLow/Y-DayHighestHigh** – lowest low/highest high of the last Y sessions (including the current one).
    b. **X-DayMaxRange** – the largest daily range (high–low) in the last X sessions.
    c. **Q%-CloseTop** – information whether today's close falls within the top Q% of the daily range.
    d. **MA(MABars)** – long-term moving average of the closing price (direction filter).
2. **Generating Entry Signals – Long Position:**
    a. **Y-DayLowestLow:** Today's candle forms the lowest low of the last Y sessions ("Y-DayLowestLow" condition).
    b. **X-DayMaxRange:** today's candle range is the largest among the last X sessions ("X-DayMaxRange" condition).
    c. **Q%-CloseTop & MA(MABars):** today's close falls within the upper Q% of the daily range ("Q%-CloseTop" condition) and above the moving average ("MA(MABars)" condition).
    d. **Entry:** Once these conditions are met, place a buy stop order one tick above today's high; the order is valid for one session only.
3. **Generating Output Signals:**
    a. **Long position:** after establishing a new Y-DayHighestHigh, close the position at the opening of the next session.
4. **Position Direction:** Long Only. The strategy focuses exclusively on long positions in an uptrend.
5. **Daily Monitoring:**
    a. Every day, determine the values: Y-DayLowestLow, Y-DayHighestHigh, X-DayMaxRange, MA(MABars) and check if the close is within the upper Q% of the daily range.
    b. The system verifies entry/exit conditions and sets appropriate buy stop orders for the next day.

The above rules are 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.

Tests are performed assuming that the risk of one position is **2.0% of the total capital,** with **a hypothetical stop loss order** set at the low of the signal candle.

Step 3: Pre-test your investment strategy

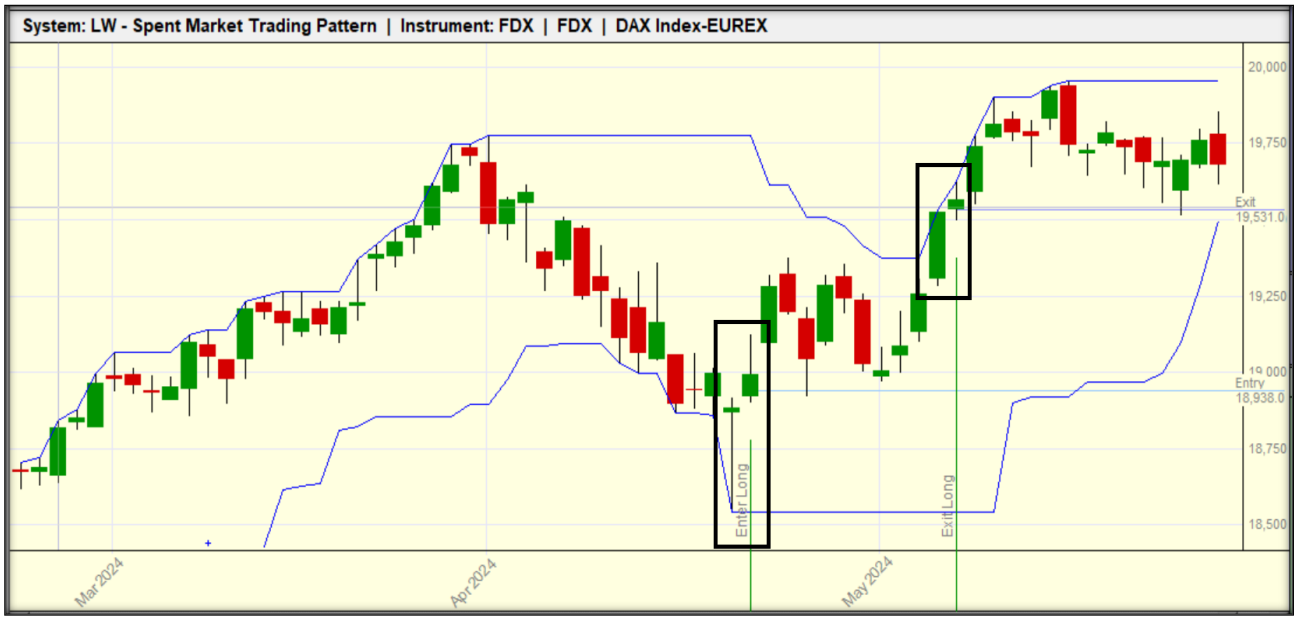
Below are some purchase and sale transactions that allow you to verify the following aspects:

- **Correctness of generated signals;**
- **Direction of opening a position;**
- **Moment of opening the position;**
- **The opening price of the position;**
- **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 doesn't matter** whether the trades are **profitable,** what **instrument was used,** or whether they occurred **recently** or **in the distant past.** The key is **to verify that the trades are generated correctly** and in line with the assumptions described in the previous step.

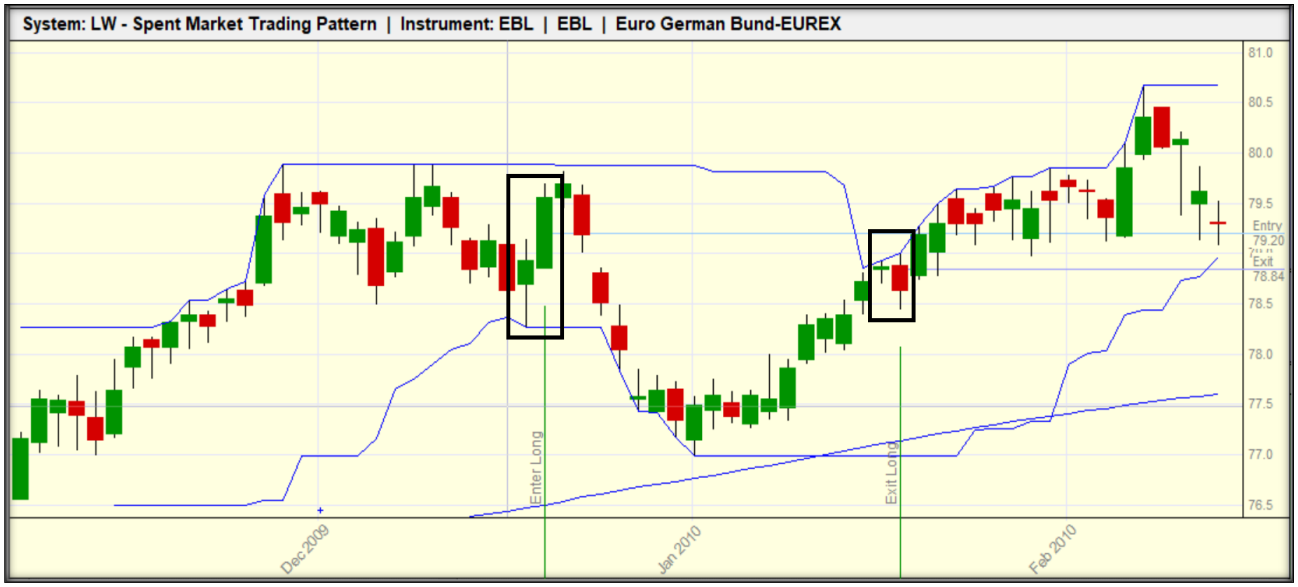
The first transaction was executed on a DAX index futures contract. In mid-April 2024, a long SMTP position signal appeared (first candle in the left-hand rectangle): **the daily candle formed a 15-session low** (Y-DayLowestLow), **had the largest range of the last 10 sessions** (X-DayMaxRange), and **closed within the upper 25% of its daily range (Q%-CloseTop) and above the 150-day moving average.** According to the strategy's rules, **a buy stop order was set for the next session one tick above the high of the signal candle. The position was opened the next day** (second candle in the left-hand rectangle). **The system worked correctly.**

The strategy assumes **closing the position once the price reaches a 15-day high.** In the example below, **after a few days, prices established new local (15-day) highs** (the first candle in the right-hand rectangle). Therefore, the position was **closed the following day at the open** (the second candle in the right-hand rectangle). **The system worked correctly.**



The second transaction was executed on a German bond futures contract. At the end of 2009, a long SMTP position signal appeared (first candle in the left-hand rectangle): **the daily candle formed a 15-session low** (Y-DayLowestLow), **had the largest range of the last 10 sessions** (X-DayMaxRange), and **closed within the upper 25% of its daily range (Q%-CloseTop) and above the 150-day moving average.** According to the strategy's rules, **a buy stop order was set for the next session one tick above the high of** the signal candle. **The position was opened the next day** (second candle in the left-hand rectangle). **The system worked correctly.**

The strategy assumes **closing the position once the price reaches a 15-session high.** In the example below, **after a dozen or so days, prices established new local (15-day) highs** (the first candle in the right-hand rectangle). Therefore, the position was **closed the following day at the opening** (the second candle in the right-hand rectangle). **The system worked correctly.** However, it is worth noting that **between the opening and closing of the position, it generated a significant loss** due to **the lack of a protective order.** Therefore, **position sizing** in this strategy requires great caution to avoid significant capital drawdowns.



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 **baseline parameters** that, in my opinion, should align with the strategy's stated goals.

First, **we reject strategies that linearly lose capital.** If a strategy exhibits this pattern, it's a clear signal that any parameter optimization is pointless.

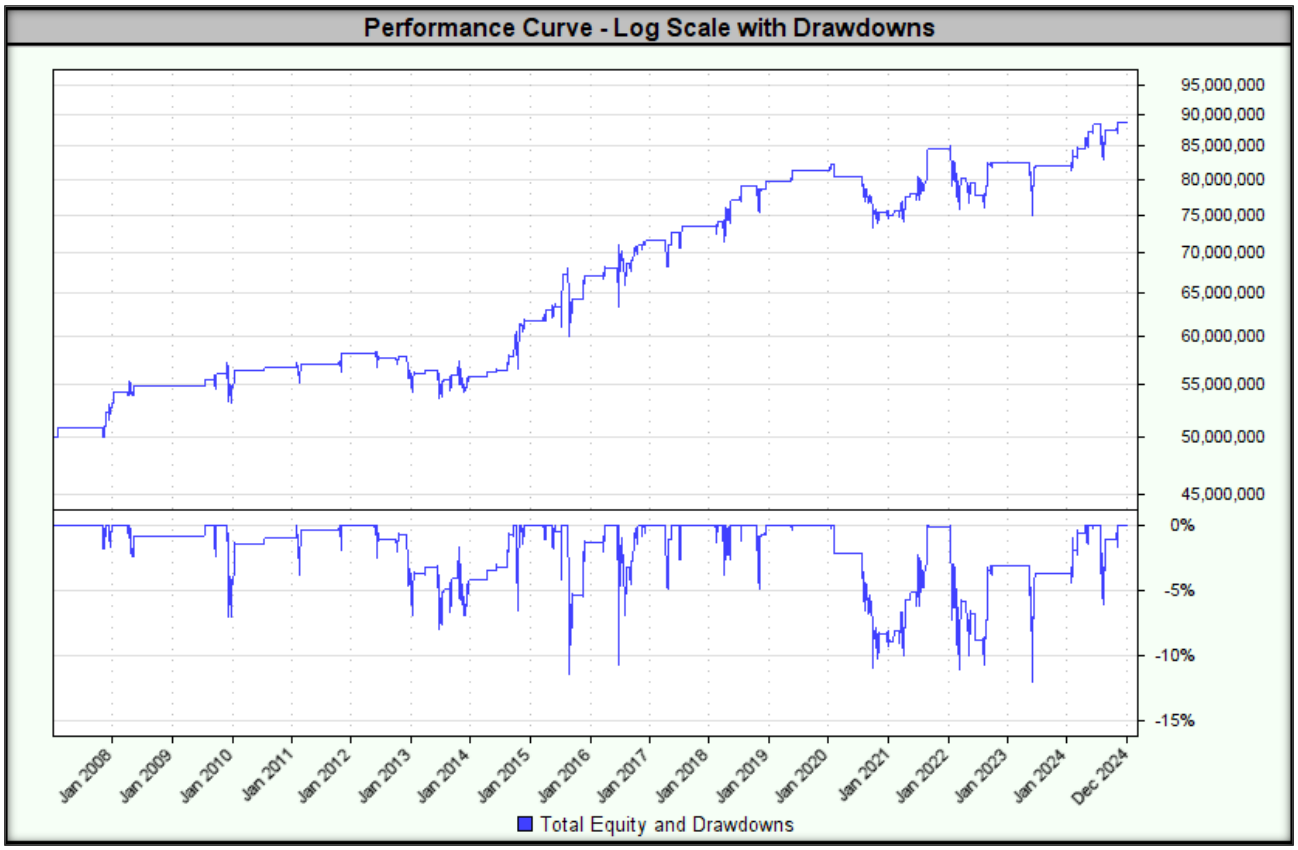
Our basic expectation is that the strategy generates **positive results,** even if they are at a low level.

Tested base parameters:

- **X-DayLowestLow/DayHighestHigh:** lowest/highest price in the last 15 days;
- **Q%-CloseTop:** close of the candle at 25% of the upper range;
- **Y-DayMaxRange:** the candle with the largest range over the last 10 days;
- **How to open a position:** buy stop one tick above the high of the signal candle;
- **Order validity:** the order remains active only in the next session;

- **Stop loss:** no stop loss order;
- **Closing the position:** once a new Y-DayHighestHigh is established, the position is closed at the opening of the next session;
- **Position direction:** long positions only;
- **Position sizes:** corresponding to a risk of 2.0% of total capital, with **a hypothetical stop loss order** set at the low of the signal candle.

The test result is shown below.



Indicators/Measures	Concluding a transaction at the opening price
CAGR%	3.24%
MAR Ratio	0.27
RAR%	3.28%
R-Cubed	0.17
Robust Sharpe Ratio	0.55
Max Drawdown	12.0%
Wins	75.0%
Losses	25.0%
Average Win%	1.35%
Average Loss%	1.70%
Win/Loss Ratio	0.80
Average Trade Duration (days)	16
Percent Profit Factor	2.39

SQN	0.78
Number of transactions	100

In summary, the system works properly and generates signals as expected. Furthermore, tests on the baseline parameters yielded satisfactory results. **The only drawback, however, is the relatively small number of transactions.** This should be kept in mind when drawing conclusions about the suitability of this strategy for real-world transactions. We can now move on to the most interesting stage of creating an investment strategy – **optimization.**

Step 4: Optimizing and assessing the stability of the investment strategy

This stage of strategy development and testing is **crucial** because it determines how **effective** the strategy will be in **real-world conditions. I cannot** emphasize enough that for **a strategy to work** in real-world conditions, it must also perform under **suboptimal parameters** and **conditions.** In short, **it must be stable** to changing market conditions.

I don't know who said these words, but they perfectly capture 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 topic of consideration in **Step 5, "Walk-Forward Analysis",** but before we get to that, **we need to know** whether our strategy is even **stable.**

1. Stability across a wide range of optimized parameters

This version **of the Spent Market Trading Pattern (SMTP) v.2 strategy involves optimizing parameters using the Grid Search** method. This method involves **fully optimizing all specified parameters by creating a wide range of possible combinations.** Our goal is to find **parameter ranges** that **will keep the strategy stable (robust),** allowing us to assess its suitability in real market conditions.

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

In the first step, we test the stability of parameters on **in-sample data.** To do this, we define **ranges of** parameter values so that **the ratio of the highest to lowest value in the range is at least 150%.**

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

- **Y-DayLowestLow/Y-DayHighestHigh:** range **14-20 days (step: 1);**
- **Q%-CloseTop:** range **20%-30% (step: 1 pp);**
- **X-DayMaxRange:** range **4-6 days (step: 1);**
- **MA(MABars):** range **80-160 days (step: 5).**

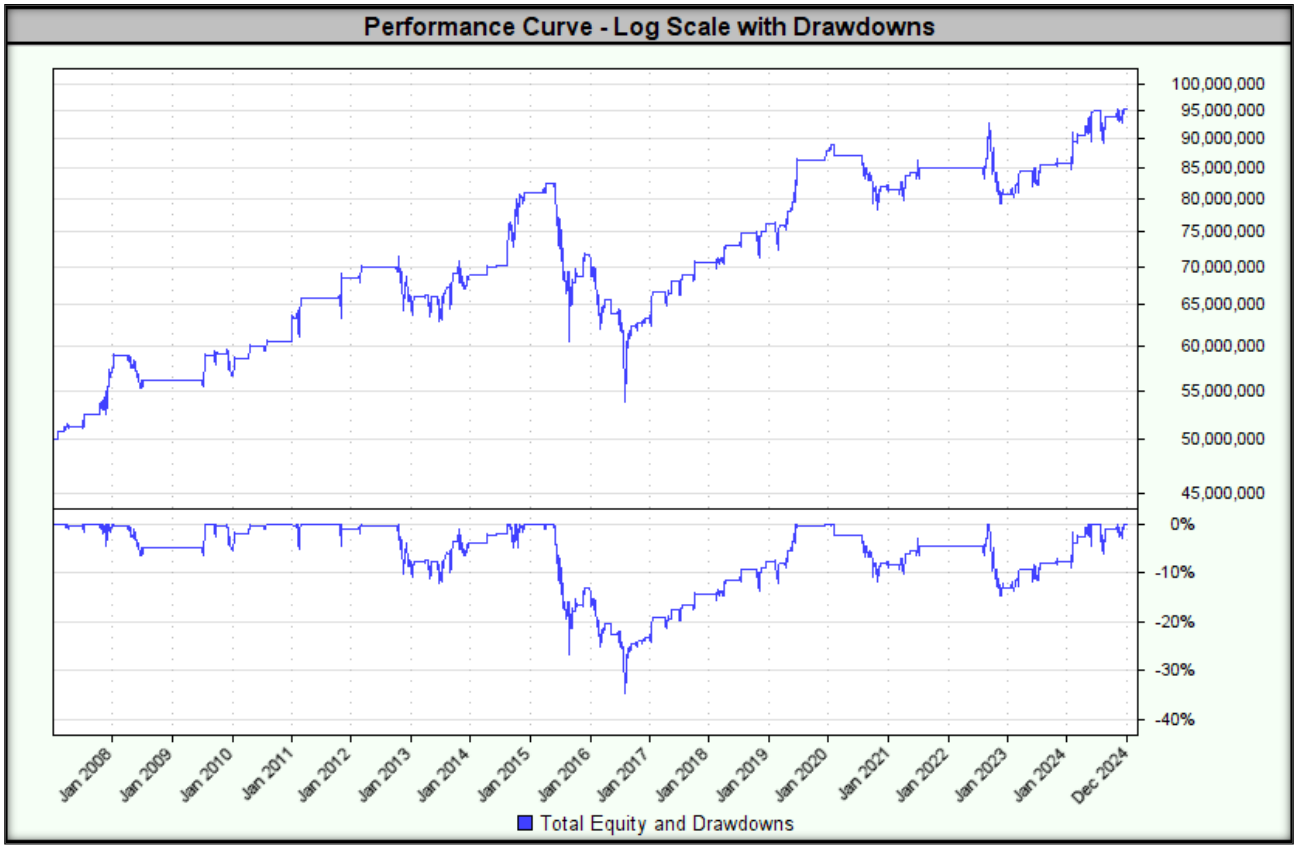
The lowest MAR value of 0.10 was achieved for the following parameters:

- **Y-DayLowestLow/Y-DayHighestHigh:** 17 days;
- **Q%-CloseTop:** 24%;
- **X-DayMaxRange:** 4 days;

- **MA(MABars):** 95 days.

Test	Highest & Lowest (Bars)	Top/Bottom Close	Largest bars in # days	Moving Average (bars)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
1891	17	24%	4	95	$95,194,865.82	3.64%	0.10	0.47	0.40	34.7%	50.0	115
1942	17	25%	4	95	$100,970,503.72	3.98%	0.11	0.50	0.45	34.7%	49.9	119
2449	18	24%	4	80	$86,141,311.00	3.07%	0.11	0.45	0.42	26.7%	56.2	98
2245	18	20%	4	80	$87,191,547.33	3.14%	0.12	0.51	0.49	26.7%	39.1	91
1888	17	24%	4	80	$88,015,825.23	3.19%	0.12	0.46	0.42	26.7%	50.5	106
2296	18	21%	4	80	$88,534,869.47	3.23%	0.12	0.52	0.49	26.7%	39.1	94
2452	18	24%	4	95	$102,227,512.53	4.05%	0.12	0.51	0.47	33.2%	49.9	108
1889	17	24%	4	85	$94,496,954.57	3.60%	0.12	0.47	0.45	29.2%	48.6	113
2450	18	24%	4	85	$98,179,797.54	3.82%	0.12	0.49	0.47	30.9%	49.9	106
1684	17	20%	4	80	$89,875,975.23	3.31%	0.12	0.53	0.50	26.7%	31.5	98
1890	17	24%	4	90	$95,480,455.21	3.66%	0.13	0.47	0.45	29.2%	48.6	114
2451	18	24%	4	90	$99,202,636.44	3.88%	0.13	0.50	0.48	30.9%	49.9	107
1993	17	26%	4	95	$108,474,271.98	4.40%	0.13	0.55	0.48	34.7%	48.6	123
2347	18	22%	4	80	$91,308,859.85	3.40%	0.13	0.53	0.49	26.7%	39.1	95
2500	18	25%	4	80	$91,330,943.80	3.40%	0.13	0.49	0.47	26.7%	50.0	102

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



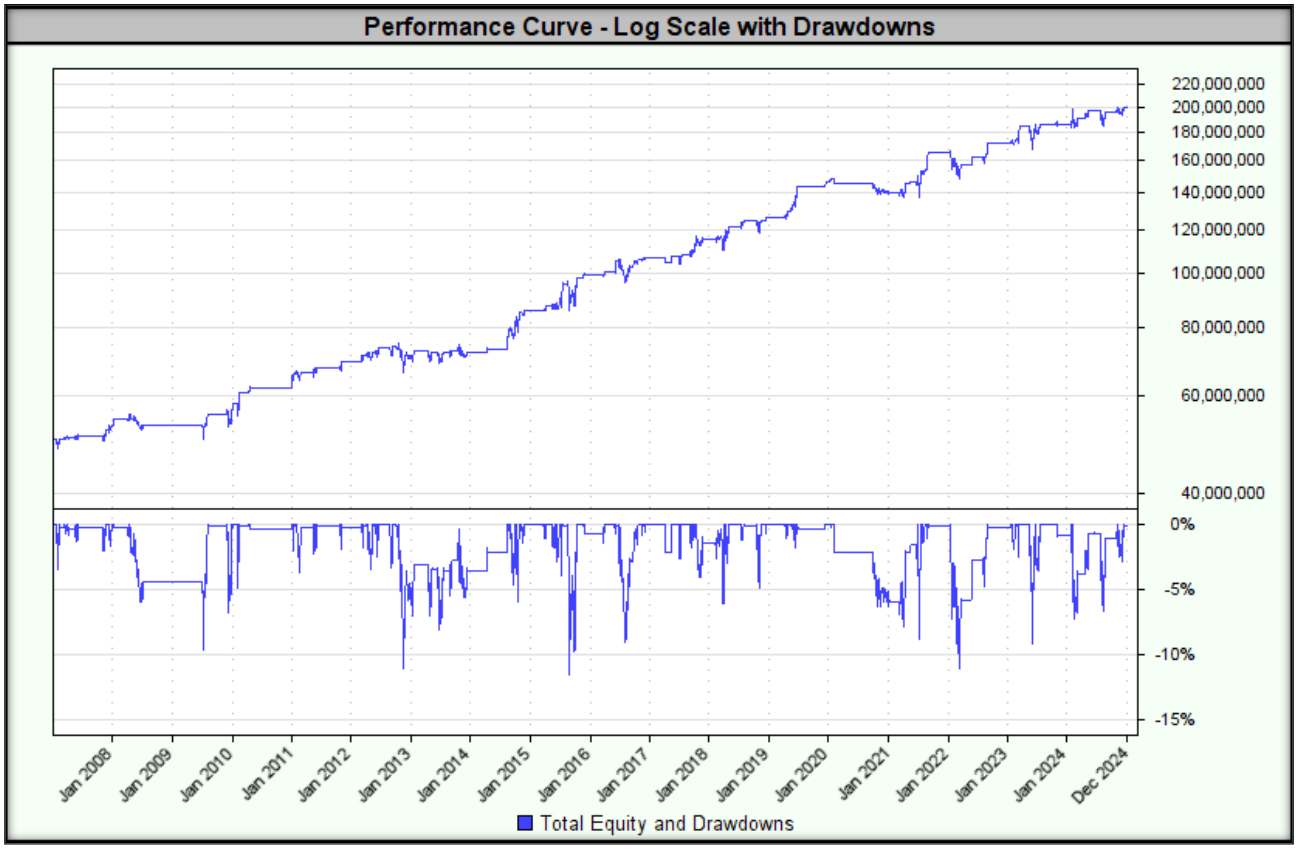
The highest MAR value of 0.70 was achieved for the following parameters:

- **Y-DayLowestLow/Y-DayHighestHigh:** 19 days;
- **Q%-CloseTop:** 27%;
- **X-DayMaxRange:** 5 days;
- **MA(MABars):** 155 days.

The highest MAR value was accompanied by **a drawdown of 11.5%.**

Test	Highest & Lowest (Bars)	Top/Bottom Close	Largest bars in # days	Moving Average (bars)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
3195	19	27%	5	155	$199,176,417.73	7.98%	0.69	1.03	1.33	11.5%	21.8	118
3246	19	28%	5	155	$194,287,693.35	7.83%	0.68	1.00	1.25	11.5%	21.8	122
3348	19	30%	5	155	$194,065,020.04	7.83%	0.68	0.99	1.25	11.5%	21.8	123
3297	19	29%	5	155	$194,065,020.04	7.83%	0.68	0.99	1.25	11.5%	21.8	123
3144	19	26%	5	155	$193,336,560.93	7.80%	0.68	1.02	1.30	11.5%	21.8	116
3093	19	25%	5	155	$185,124,871.52	7.54%	0.66	0.99	1.22	11.5%	21.8	114
3858	20	29%	5	155	$180,706,276.77	7.40%	0.64	0.93	1.13	11.5%	21.8	116
3909	20	30%	5	155	$180,706,276.77	7.40%	0.64	0.93	1.13	11.5%	21.8	116
3756	20	27%	5	155	$179,874,621.87	7.37%	0.64	0.95	1.19	11.5%	21.8	111
3807	20	28%	5	155	$177,781,050.62	7.30%	0.64	0.93	1.12	11.5%	21.8	115
1495	16	27%	4	155	$240,243,971.77	9.11%	0.63	1.02	1.28	14.4%	19.3	161
2991	19	23%	5	155	$174,600,958.13	7.19%	0.63	0.96	1.19	11.5%	21.8	110
3042	19	24%	5	155	$174,600,958.13	7.19%	0.63	0.96	1.19	11.5%	21.8	110
3705	20	26%	5	155	$174,599,890.67	7.19%	0.63	0.94	1.16	11.5%	21.8	109
1546	16	28%	4	155	$236,534,259.90	9.02%	0.63	1.00	1.26	14.4%	19.3	166

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 34.7%.**

Test	Highest & Lowest (Bars)	Top/Bottom Close	Largest bars in # days	Moving Average (bars)	End Balance	CAGR%	MAR	Sharpe	Ann. Sharpe	Max TE DD	Longest DD	Trades
1942	17	25%	4	95	$100,970,503.72	3.98%	0.11	0.50	0.45	34.7%	49.9	119
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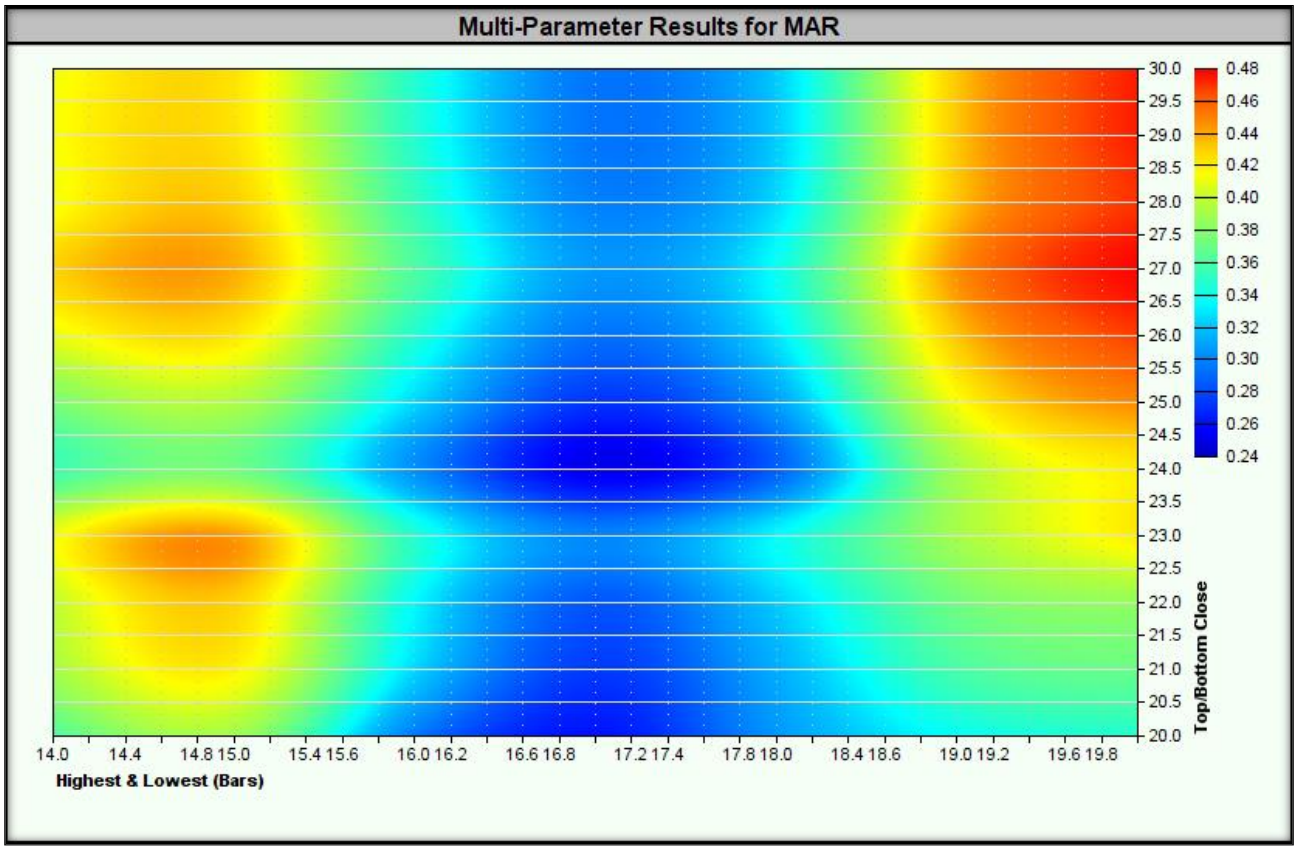
1993	17	26%	4	95	$108,474,271.98	4.40%	0.13	0.55	0.48	34.7%	48.6	123
2452	18	24%	4	95	$102,227,512.53	4.05%	0.12	0.51	0.47	33.2%	49.9	108
2554	18	26%	4	95	$114,989,393.57	4.74%	0.14	0.58	0.55	33.2%	44.1	115
2503	18	25%	4	95	$108,460,667.24	4.40%	0.13	0.55	0.52	33.2%	49.3	112
2044	17	27%	4	95	$116,091,360.69	4.79%	0.15	0.60	0.54	32.0%	39.2	126
2146	17	29%	4	95	$114,308,584.59	4.70%	0.15	0.58	0.54	32.0%	39.1	130
2095	17	28%	4	95	$114,308,584.59	4.70%	0.15	0.58	0.54	32.0%	39.1	130
2197	17	30%	4	95	$114,308,584.59	4.70%	0.15	0.58	0.54	32.0%	39.1	130
2552	18	26%	4	85	$110,415,939.85	4.50%	0.15	0.56	0.56	30.9%	39.2	113
2553	18	26%	4	90	$111,577,263.78	4.56%	0.15	0.57	0.56	30.9%	39.2	114
2450	18	24%	4	85	$98,179,797.54	3.82%	0.12	0.49	0.47	30.9%	49.9	106
2501	18	25%	4	85	$104,150,518.58	4.16%	0.13	0.53	0.52	30.9%	48.6	110
2502	18	25%	4	90	$105,252,825.04	4.22%	0.14	0.53	0.52	30.9%	48.6	111

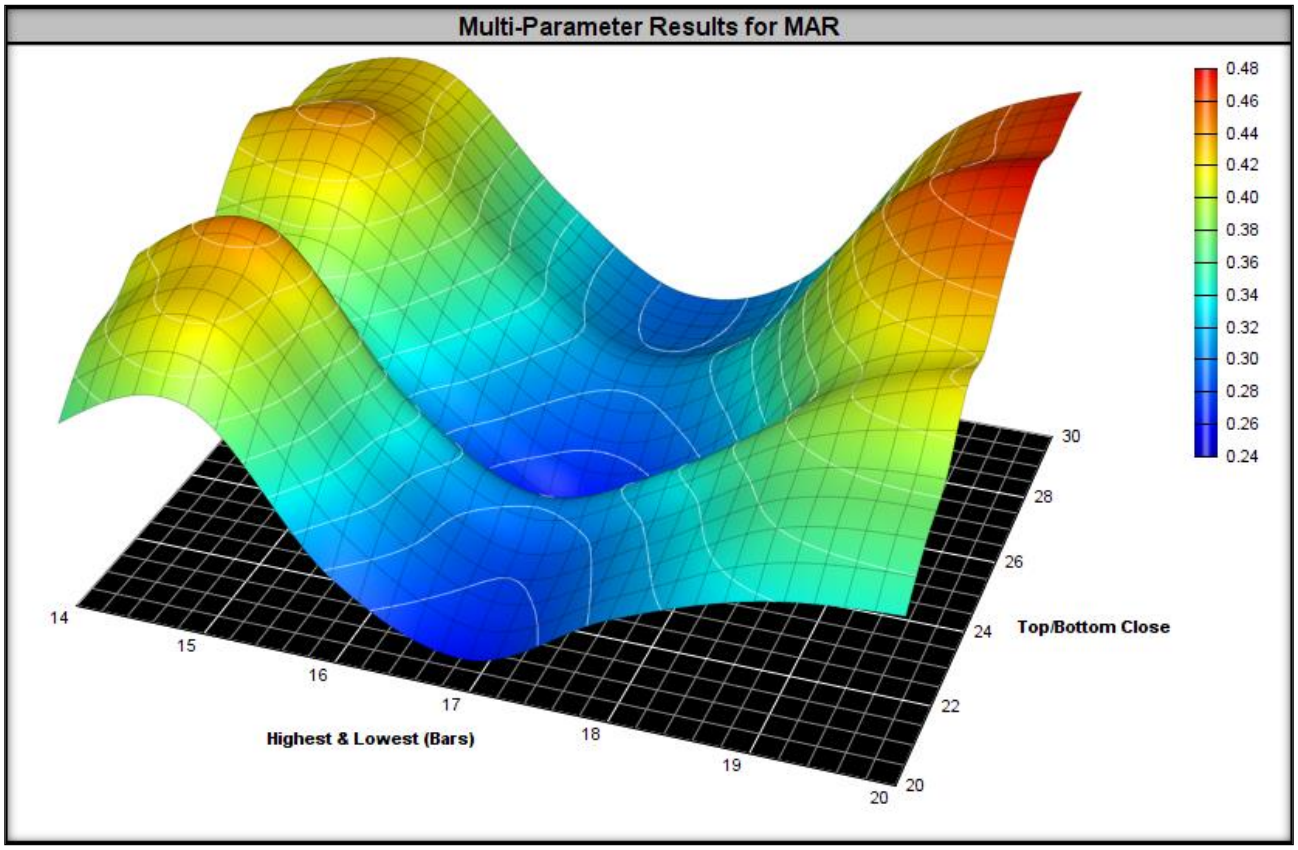
In summary, the strategy **failed the stability test** over a wide range of optimized parameters because:

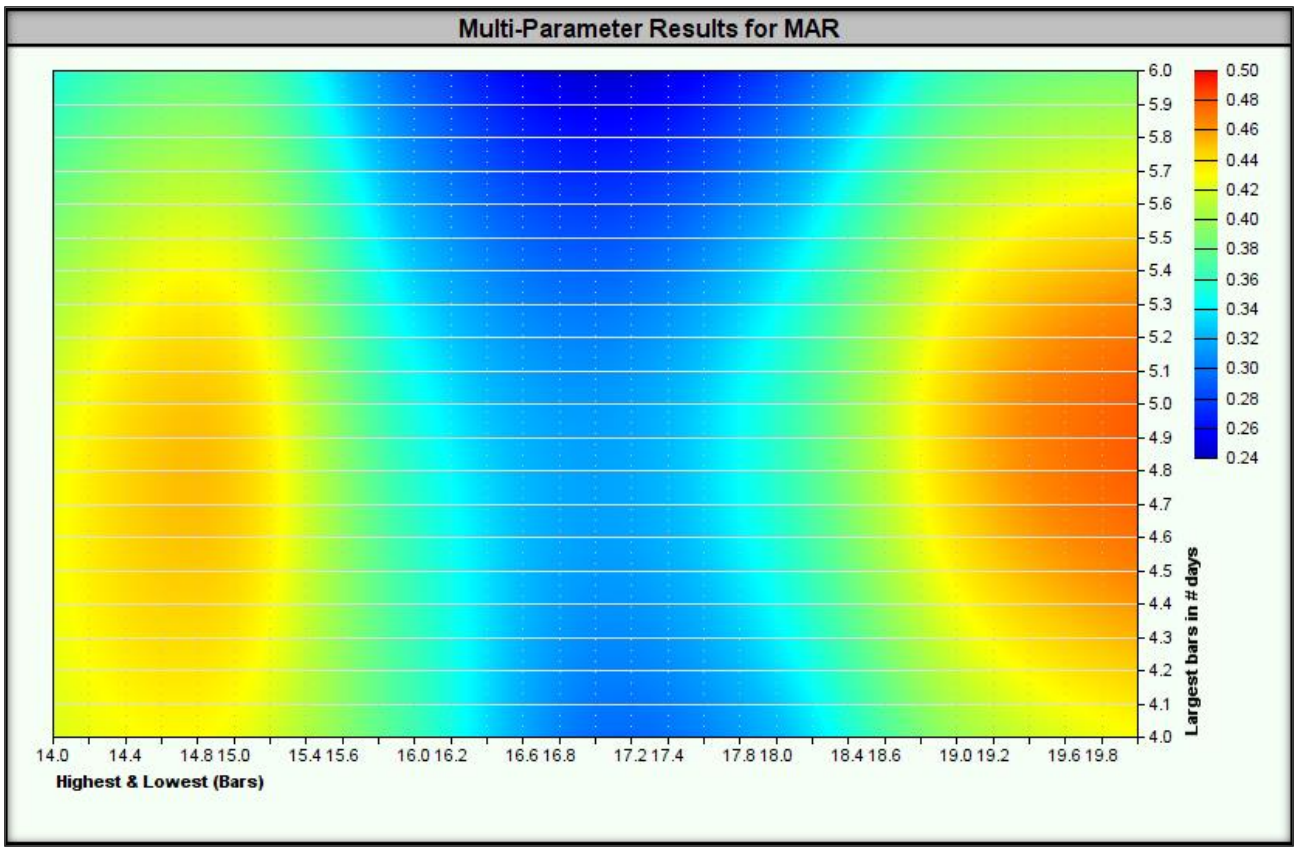
- **The maximum drawdown exceeded 250% of the drawdown value** for the result with the highest MAR (**34.7% vs. 11.5%)** – which means a high risk of deep capital drawdowns.

Therefore, **<u>further testing of the strategy is not justified,</u>** as its use in real transactions **is highly doubtful.**

Heatmaps for the tested ranges are shown below.




Multi-Parameter Results for MAR
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
14
15
16
17
18
19
20
Highest & Lowest (Bars)
20
22
24
26
28
30
Top/Bottom Close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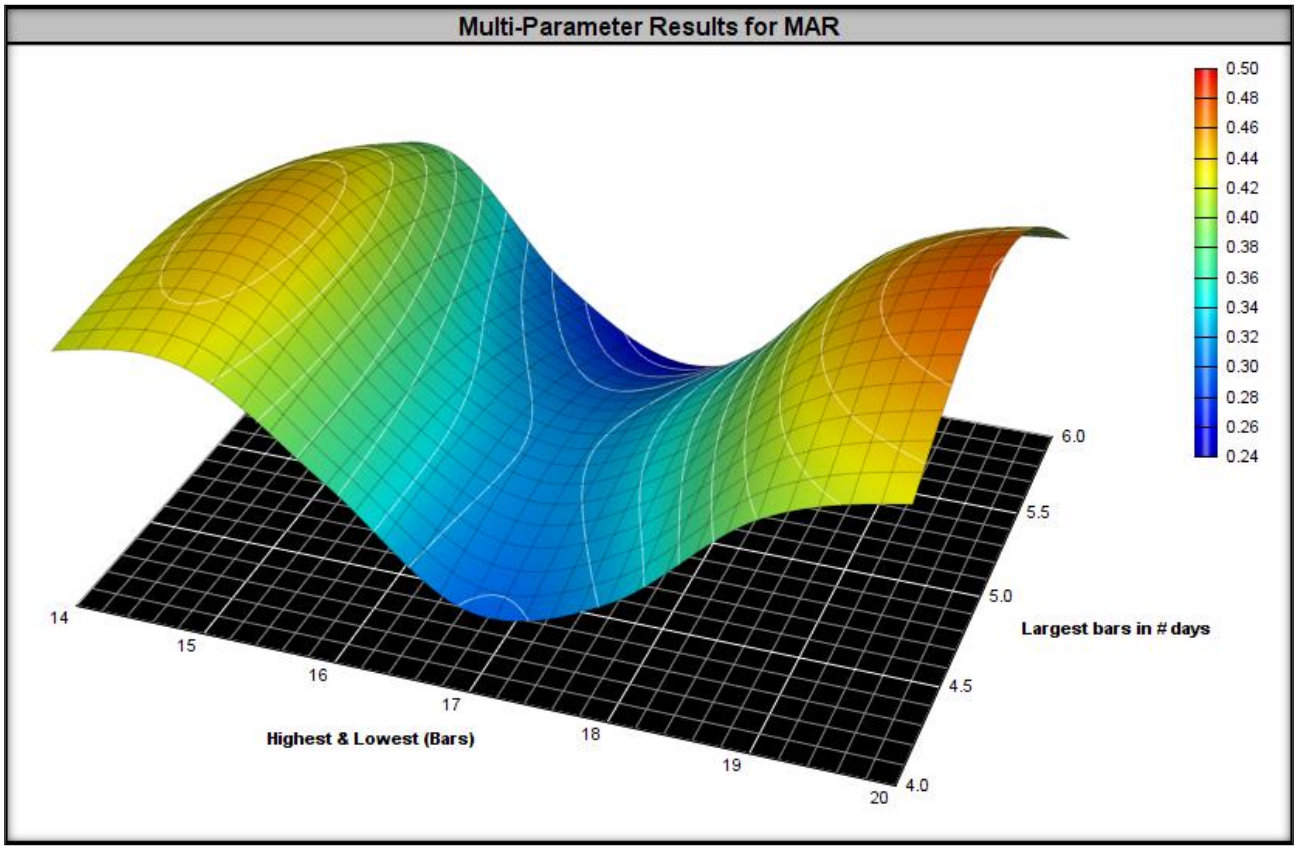
0.28
0.26
0.24
6.0
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
Largest bars in # days
14.0
14.4
14.8 15.0
15.4 15.6
16.0 16.2
16.6 16.8
17.2 17.4
17.8 18.0
18.4 18.6
19.0 19.2
19.6 19.8
Highest & Lowest (Bars)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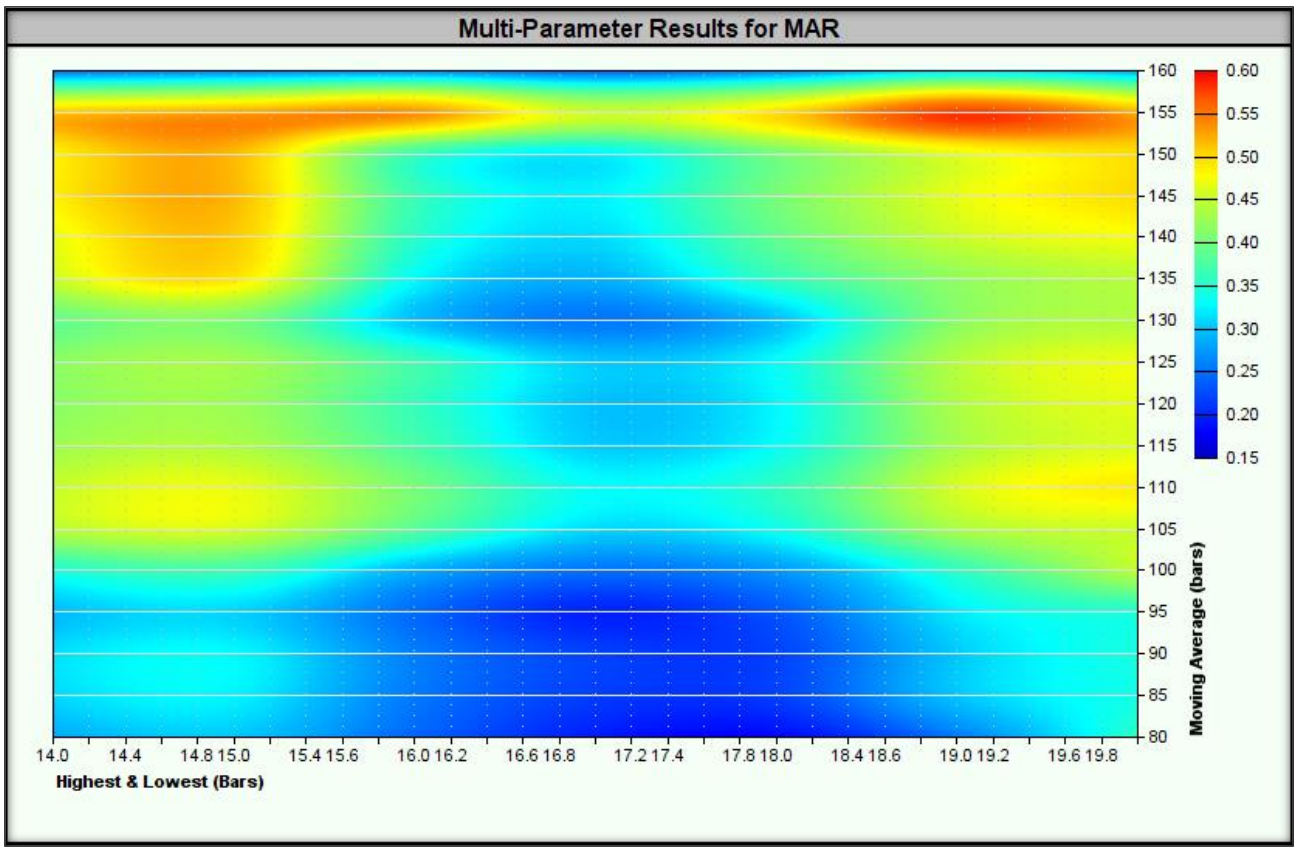
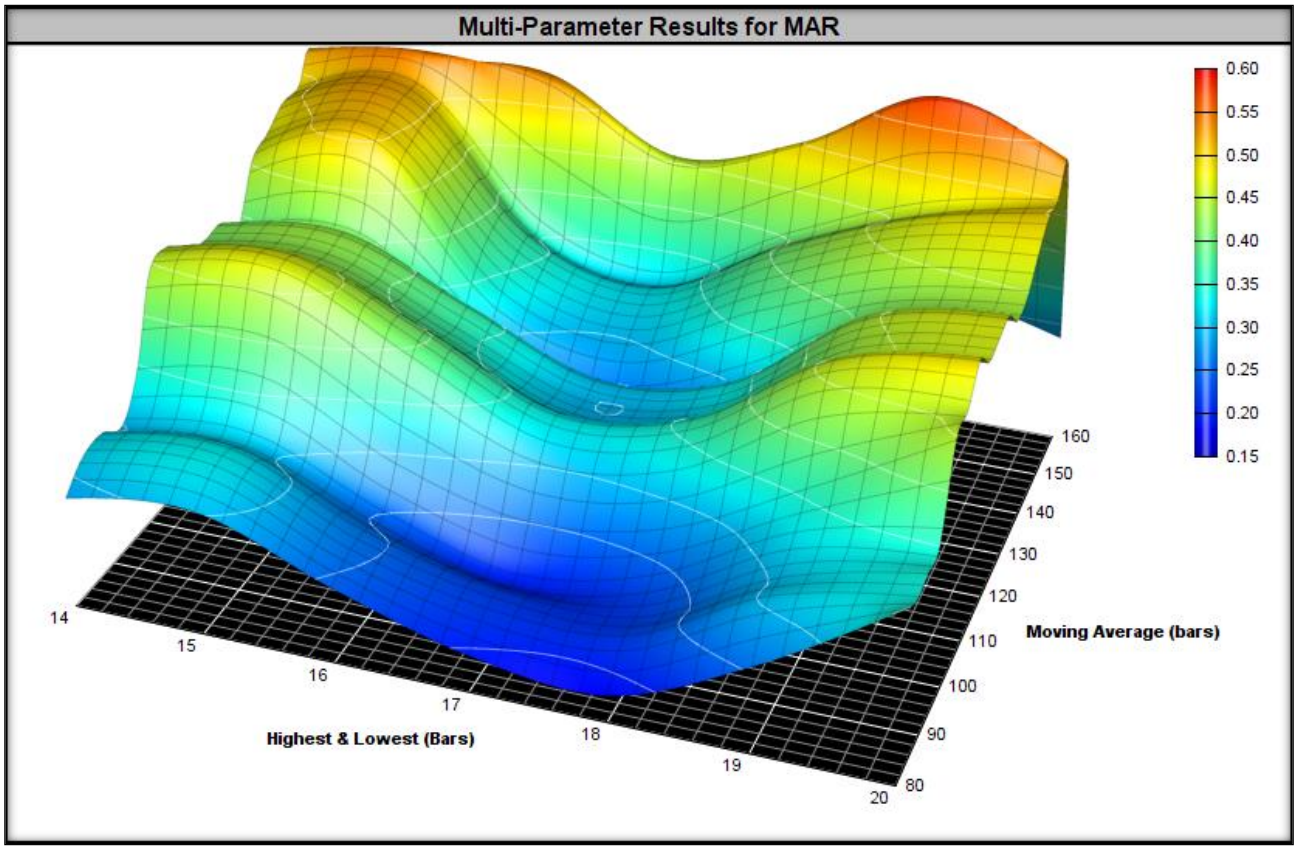
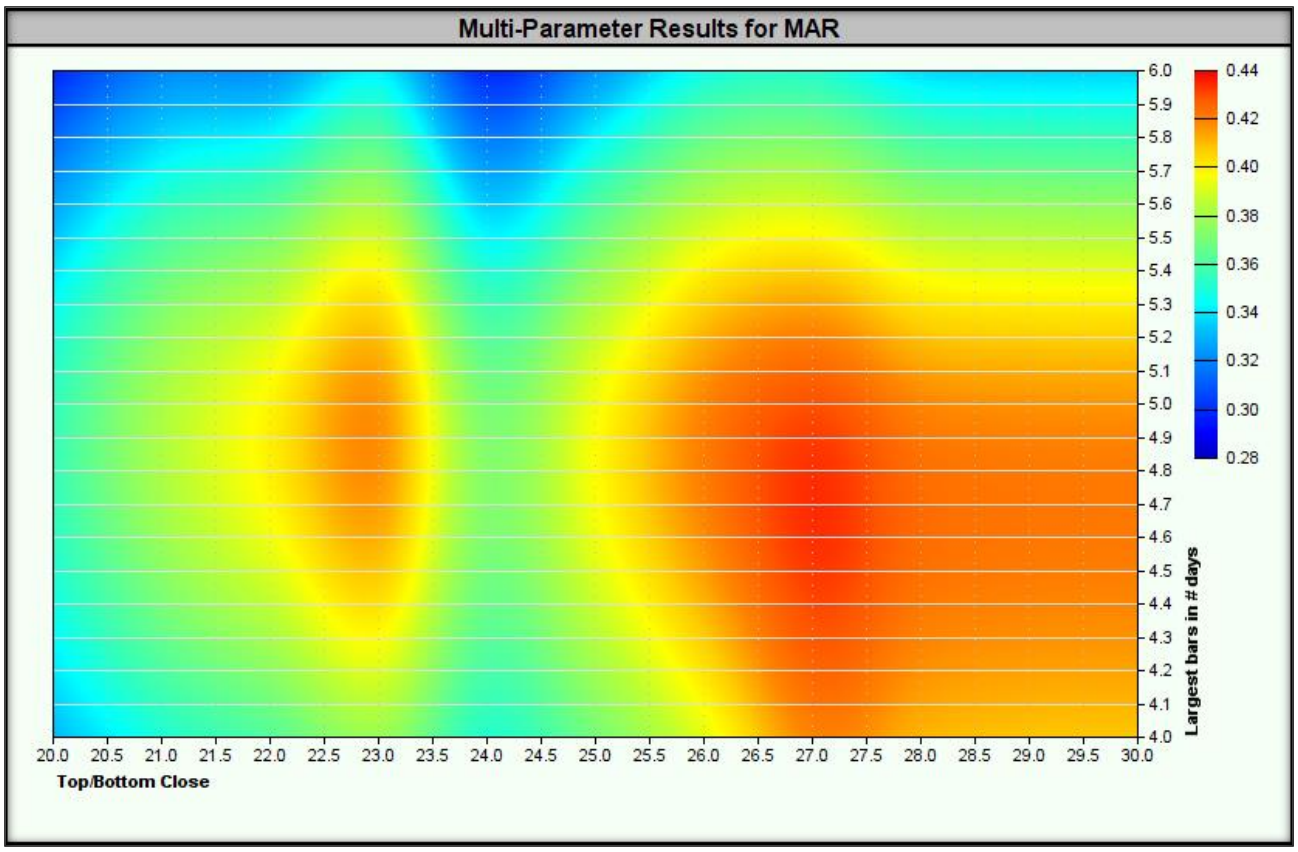
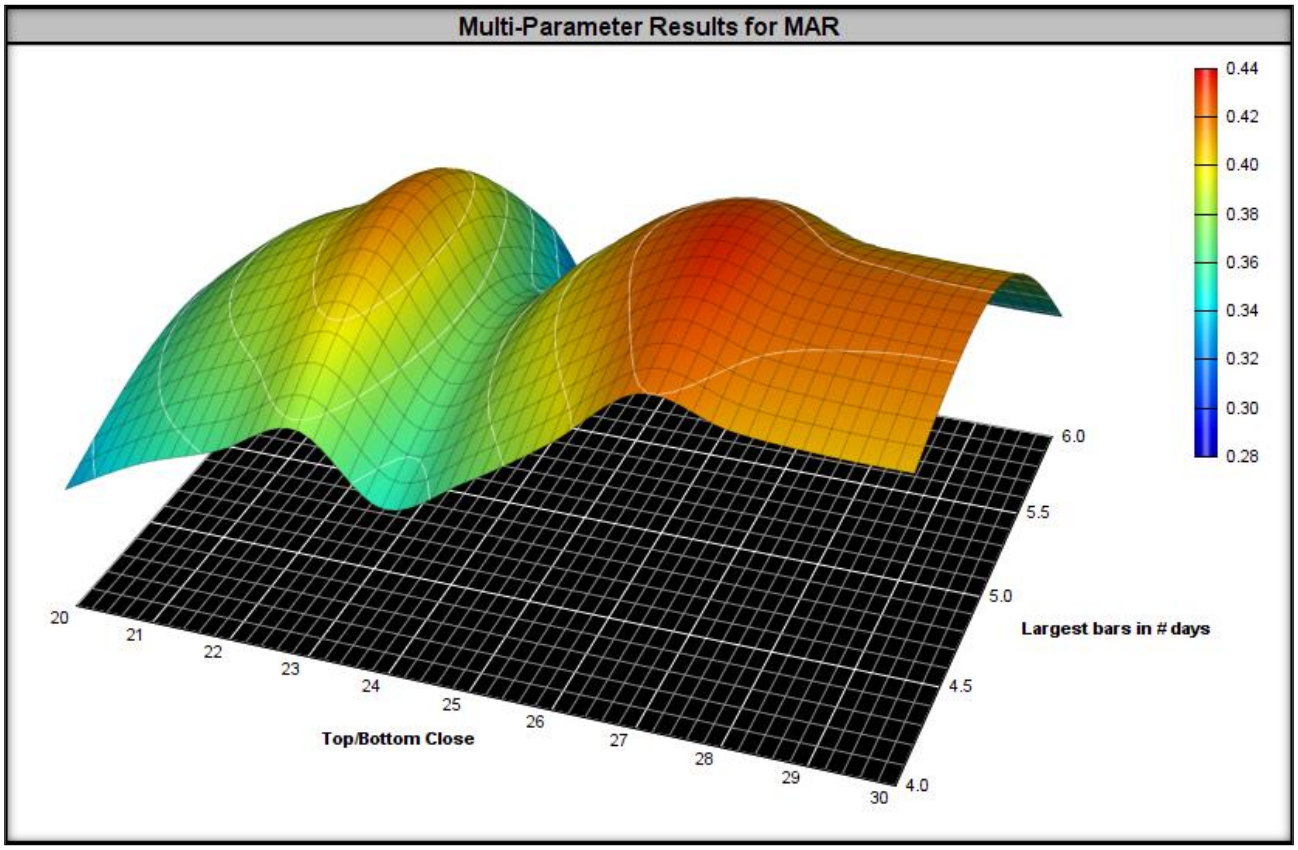
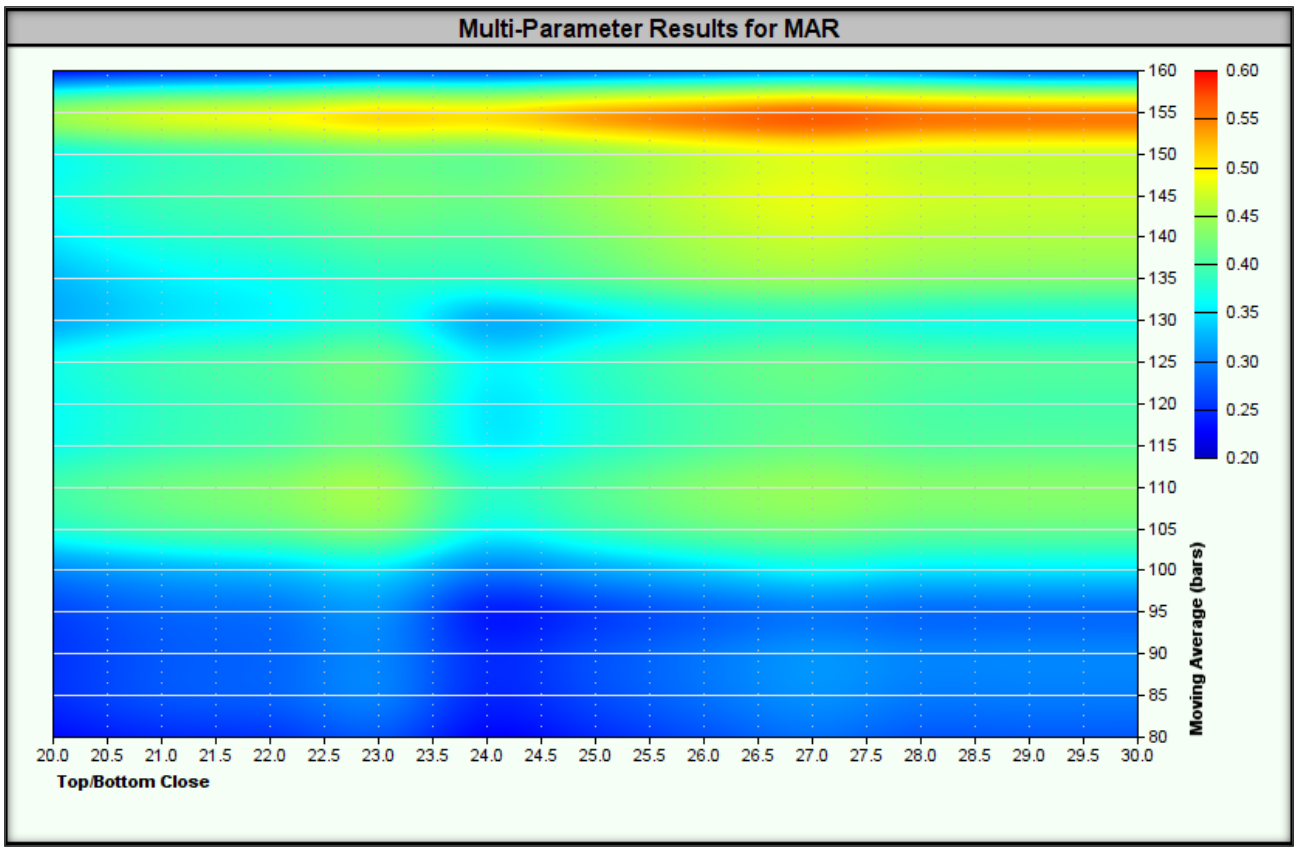
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.26
0.24
14
15
16
17
18
19
20
Highest & Lowest (Bars)
6.0
5.5
5.0
4.5
4.0
Largest bars in # days

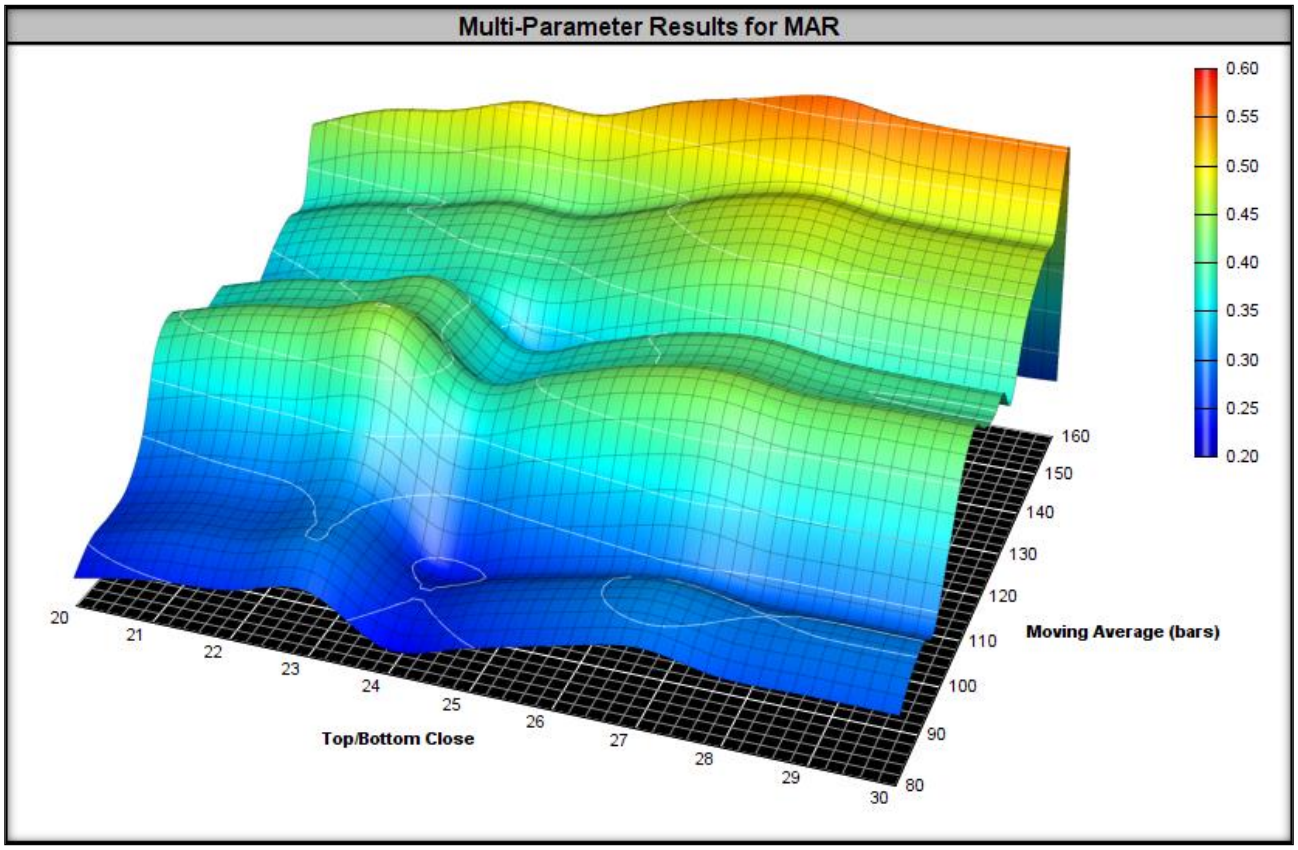

Multi-Parameter Results for MAR
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
160
155
150
145
140
135
130
125
120
115
110
105
100
95
90
85
80
Moving Average (bars)
14.0
14.4
14.8 15.0
15.4 15.6
16.0 16.2
16.6 16.8
17.2 17.4
17.8 18.0
18.4 18.6
19.0 19.2
19.6 19.8
Highest & Lowest (Bars)

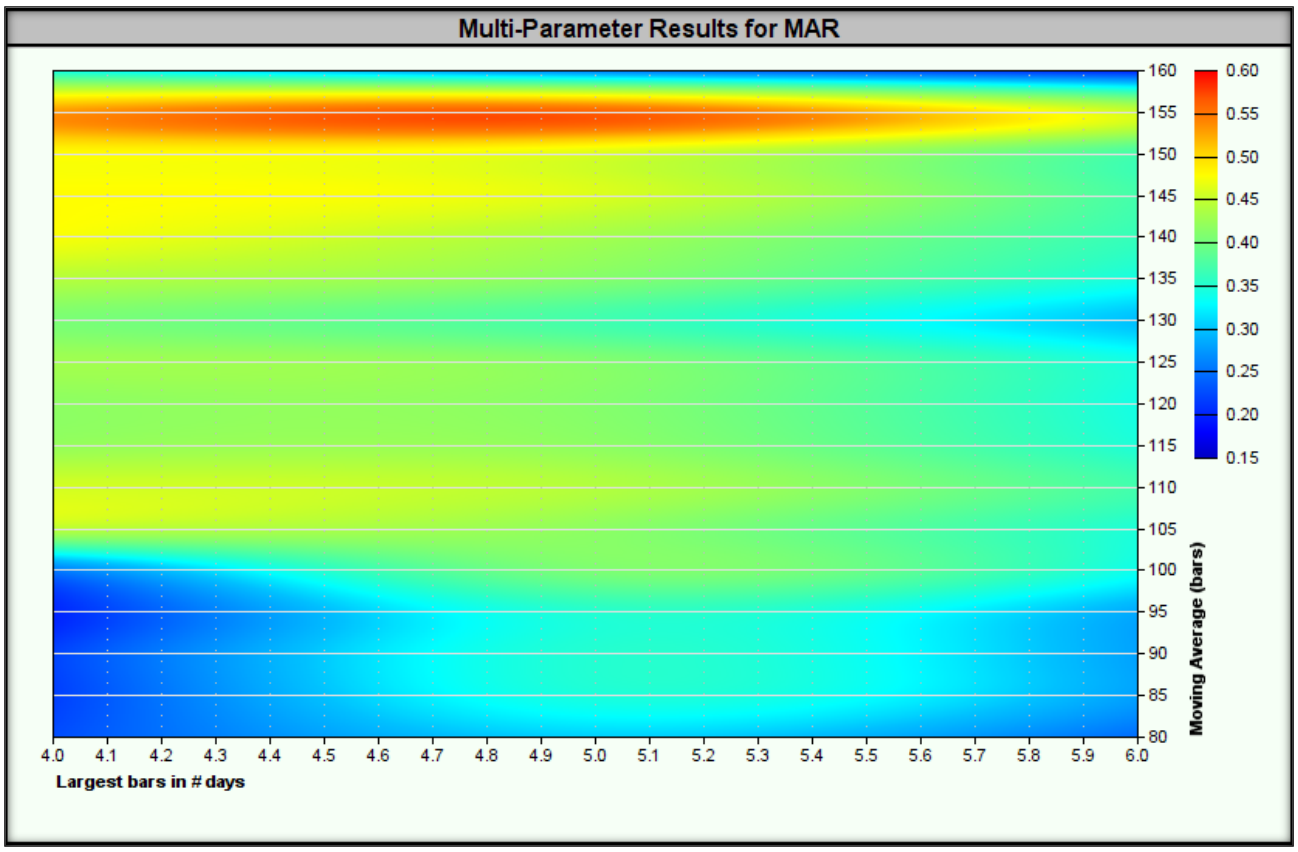

Multi-Parameter Results for MAR
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
160
150
140
130
120
110
100
90
80
Moving Average (bars)
14
15
16
17
18
19
20
Highest & Lowest (Bars)

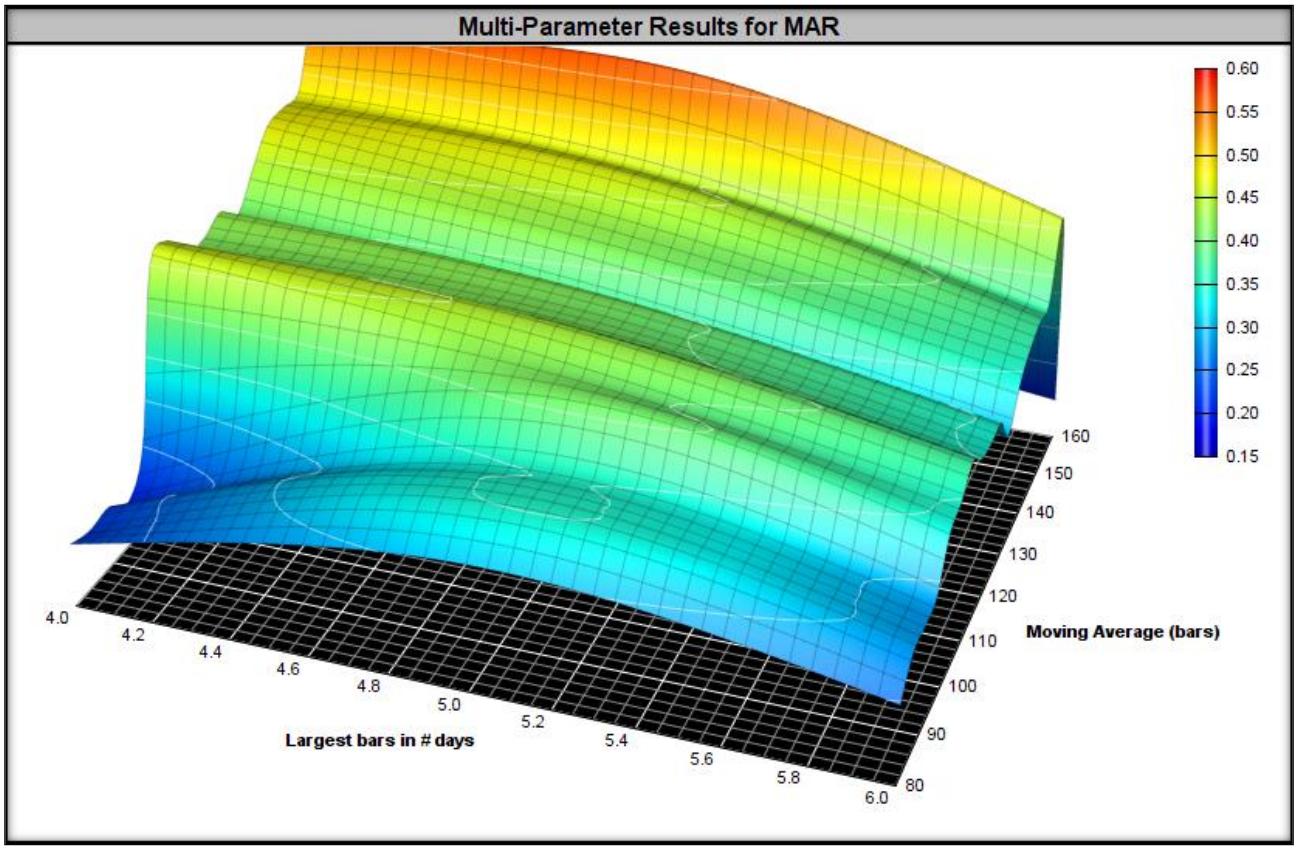

Multi-Parameter Results for MAR
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
6.0
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
Largest bars in # days
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
Top/Bottom Close

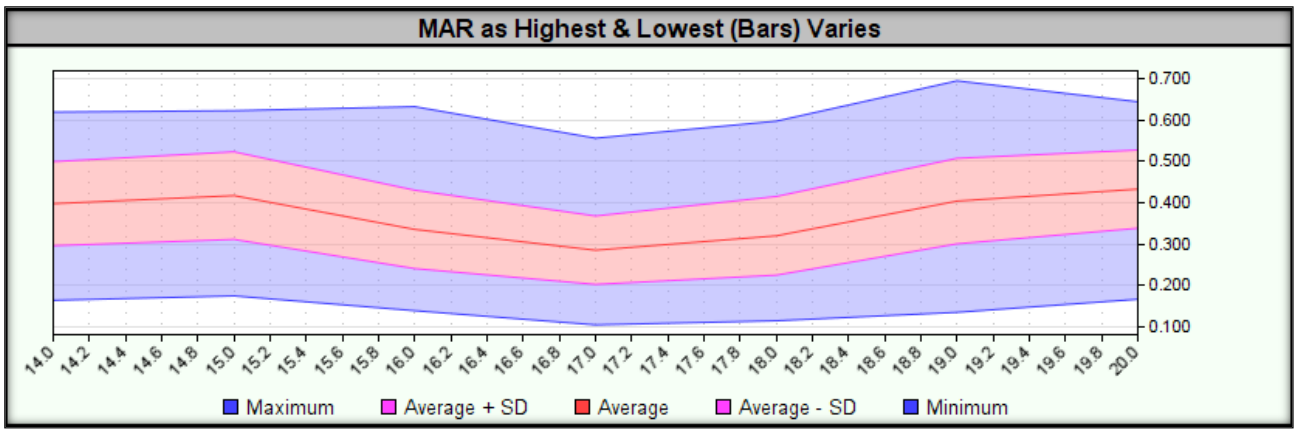

Multi-Parameter Results for MAR
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
6.0
5.5
5.0
4.5
4.0
Largest bars in # days
20
21
22
23
24
25
26
27
28
29
30
Top/Bottom Close

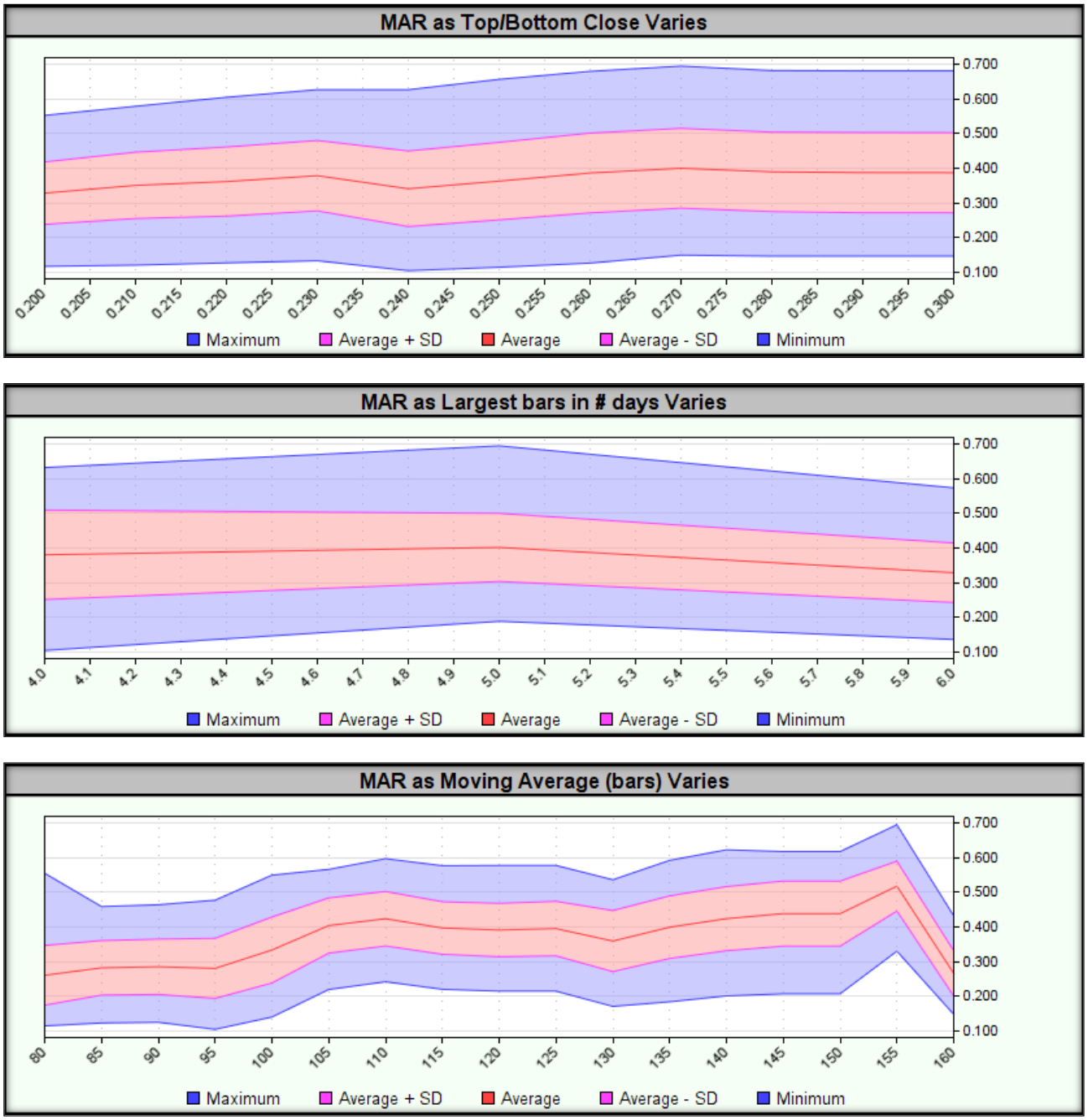

Multi-Parameter Results for MAR
160
155
150
145
140
135
130
125
120
115
110
105
100
95
90
85
80
Moving Average (bars)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
20.0
20.5
21.0
21.5
22.0
22.5
23.0
23.5
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
28.0
28.5
29.0
29.5
30.0
Top/Bottom Close


Multi-Parameter Results for MAR
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
160
150
140
130
120
110
100
90
80
Moving Average (bars)
20
21
22
23
24
25
26
27
28
29
30
Top/Bottom Close


Multi-Parameter Results for MAR
160
155
150
145
140
135
130
125
120
115
110
105
100
95
90
85
80
Moving Average (bars)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.6
5.7
5.8
5.9
6.0
Largest bars in # days


Multi-Parameter Results for MAR
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
160
150
140
130
120
110
100
90
80
Moving Average (bars)
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
Largest bars in # days


MAR as Highest & Lowest (Bars) Varies
0.700
0.600
0.500
0.400
0.300
0.200
0.100
14.0
14.2
14.4
14.6
14.8
15.0
15.2
15.4
15.6
15.8
16.0
16.2
16.4
16.6
16.8
17.0
17.2
17.4
17.6
17.8
18.0
18.2
18.4
18.6
18.8
19.0
19.2
19.4
19.6
19.8
20.0
Maximum
Average + SD
Average
Average - SD
Minimum



2. **Monte Carlo simulation**

The step was omitted due to **failure of previous stability tests.**

3. **Stability over a moving time window**

The step was omitted due to **failure of previous stability tests.**

4. **Long/short stability**

The step was omitted due to **failure of previous stability tests.**

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

The step was omitted due to **failure of previous stability tests.**

6. **Money Management (Position Sizing)**

The step was omitted due to **failure of previous stability tests.**

7. **Strategy Risk Management**

The step was omitted 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 in real-world market conditions.** It provides **reliable measures of reward and risk** after the optimization process and allows you to answer 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 more **reliable and realistic measures 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, minimizing 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)**.
    - This step adjusts the parameters 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 metric that assesses a strategy's potential to perform under real-world market conditions. WFE compares:

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

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

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

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

The step was omitted due to **failure of previous stability tests.**

Step 6: Using the strategy in real time

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

The most important element **of strategy execution** is **consistent execution of all signals, without exception. As Larry Williams noted:** *"Trading strategies work. Traders do not."*

Before making **a final decision to implement a strategy,** it's important to verify **whether it actually adds value** to the overall portfolio performance. It doesn't make sense to implement a strategy that **generates similar signals** or **has a similar equity curve.**

Key criteria for evaluating strategies 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** or **none of them are met.**

Once you decide to add a strategy to your portfolio, **the question arises:** *Should you implement the strategy immediately 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 detect **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 approximately half the maximum drawdown** observed in historical data. **Only after this threshold is reached 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 on its full implementation 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.