

## ES Daily MVS With Adaptive Batch Exits and Adaptive Contract Sizing

The starting point for this adaptive merged voting system was 7 part MVS in Earik Beann's Mechanical Trading Systems book. After initial testing, I decided to remove the Chicago Hive and R11 subsystems and began adding my own in an attempt to increase profit and reduce MDD. The following is a brief summary of all 9 subsystems in this version.

### Subsystems

1. GP1: From book
2. GP2: From book
3. BCI: From book
4. Lunar Reversal: From book
5. USM Inverse: From book
6. EH Hive:
  - a. AMA with length of 8 to 16
  - b. FT, ROC, TSI, USM with lengths of 16 to 24
  - c. Was originally created of intraday system but worked well with daily system as well. Should explore replacing this or adding additional hives in the future
7. EH GP:
  - a. Bollingerband – length of 10 with sdev of 2
  - b. USM – length of 10
  - c. AMA – length of 5
  - d. AMA – length Of 10
  - e. Additional indicator created by GA that I'm not sure how it exactly works
8. EH Bollinger Bands with Signal Retention:
  - a. Simplified version of non-adaptive standalone Bollinger bands trading system that retains the buy or sell signal for a certain number of bars after occurrence
  - b. Ideal parameters found to be different once integrated into merged system  
Length of 12 with sdev of 2.2 in mode 1 with 4 bar signal retention
9. EH Momentum Divergence: detects price and momentum divergence as follows
  - a. Identifies reversal patterns using regex on candlesticks
  - b. Tracks individual USMs for possible long and short divergence (optimized individually)
  - c. Each time a reversal pattern is identified, it logs the momentum value on that bar in an array
  - d. When the next reversal pattern is identified, it checks back through the array for all previous reversal patterns where closing price was greater (for long divergence) or less (for short divergence) and compares momentum values

- e. If momentum shows divergence, based on required momentum difference var, then it gives a long or short signal
- f. As it is checking back for previous reversal patterns, it continues checking until it finds an instance where the price was not greater (for long) or was not less (for short). This allows it to take into account larger reversal patterns that may be missed if it only checked the previous reversal pattern found. Essentially, if none of the smaller reversal patterns indicate divergence, it continues checking for larger divergence patterns.
- g. It will only continue checking back within the specified max divergence timeframe var

## **Entries**

All of the subsystems described above get a vote on whether to go long or short. The total of these votes is then summed and trading decision is made on whether to go long or short.

## **Exits**

A batch exit system is utilized that is based off the profitable close exit system demonstrated in Earik Beann's Lunar Reversal system.

Think of each batch as essentially being a bucket of contracts. Every time the system completes a trade it recalculates the batches by going through a loop and dropping one contract into each bucket/batch. It does this after each trade as the base contract size could have changed either due to dynamic position sizing (if account size crosses a threshold) or if a win/loss streak adjustment occurred. It does this in order so if the contract size is not divisible by 5, the first several batches/buckets will have more contracts. This helps to increase accuracy as it will get rid of more contracts for a profit faster. Here is an example if the system was trading 7 contracts (each number represents contracts in one of the five buckets).

2 2 1 1 1

## **Long Exit System**

Backtesting revealed that splitting the exit into 5 "batches" and exiting a batch of contracts on each successive profitable close to be the most optimal for long trades. The last two batches however, are held until the system indicates you should reverse the position. This again was determined to be the best compromise between holding all contracts until a reversal signal and exiting a batch on each successive profitable close.

## **Short Exit System**

While I did lots of experimenting to try and find the ideal number of batches for short trades, in the end I determined that not utilizing a batch exit system for shorts resulted in the most profit and lowest MDD. This makes sense as sell offs in the market tend to be fast and extreme so you want to hold all of your contracts until the system says it is time to reverse.

By implementing the batch exit system for long trades, the average MDD becomes \$12,605 per contract which is an improvement over the \$15,337.50 MDD without the batch exit system.

See comments in code to determine how to change settings for both long and short batch exit systems.

## **Stops**

I experimented with a number of different stop strategies and other ideas for trying to reduce MDD. Using a standard ATR stop with same multiplier for long and short positions did not show improvements. In fact, in most cases it increased the MDD by a considerable amount (in some cases by more than 50%). I did begin to see more favorable results after using separate multipliers for long and short stops and eventually settled on using a multiplier of 13 for longs and 5 for shorts. For longs, with an ATR multiplier of 13, the stop is never hit. Whenever long positions were stopped out, it either decreased profit or increased MDD too much to my liking. This makes sense as market sell offs that resulted in larger losses are usually very quick and eventually recover. This could change if we do enter a bear market but this value is easy to optimize again. For now, the long ATR stop is acting as an emergency stop and in most cases will limit a loss to no more than 200 points per contract.

For shorts, I discovered that using a tighter ATR multiplier of 5 was ideal. This did not decrease MDD or largest loss but did increase profit as it removed several medium sized losses. This confirms that the largest losses occurred on long positions. Allowing short positions to get stopped out faster makes sense as the largest losses for shorts happen due to long extended moves upwards where it continues to creep higher every day and usually do not result in a large correction that allows the system to get out for a smaller loss like often happens with the larger long losses.

Here are screenshots of the individual Long and Short stop optimization runs.

## Long Stop Optimization

Optimization Results											
	Parameters	Profit/Loss	Accuracy	Num. Trades	Avg. Win	Avg. Loss	Avg. Trade	Win/Loss Ratio	Profit Factor	Max. Drawdown	Max. DD %
1	#1#=3	\$1,314,917.50	75.54%	1705	\$3,172.07	(\$4,400.27)	\$1,320.06	0.7	2.2	(\$78,315.00)	-48.80%
2	#1#=3.5	\$1,440,682.50	75.69%	1715	\$3,222.42	(\$4,286.63)	\$1,396.60	0.8	2.3	(\$81,117.50)	-41.95%
3	#1#=4	\$1,521,305.00	75.61%	1722	\$3,227.43	(\$4,197.87)	\$1,416.38	0.8	2.4	(\$84,710.00)	-52.02%
4	#1#=4.5	\$1,471,462.50	75.55%	1722	\$3,229.89	(\$4,306.23)	\$1,387.44	0.8	2.3	(\$84,710.00)	-52.02%
5	#1#=5	\$1,513,522.50	75.48%	1725	\$3,231.01	(\$4,203.52)	\$1,407.93	0.8	2.4	(\$84,710.00)	-52.02%
6	#1#=5.5	\$1,574,827.50	75.61%	1734	\$3,241.06	(\$4,143.75)	\$1,439.57	0.8	2.4	(\$63,800.00)	-29.24%
7	#1#=6	\$1,613,290.00	75.60%	1738	\$3,284.18	(\$4,168.15)	\$1,466.12	0.8	2.4	(\$63,800.00)	-29.24%
8	#1#=6.5	\$1,626,152.50	75.62%	1739	\$3,288.54	(\$4,155.24)	\$1,473.61	0.8	2.5	(\$63,800.00)	-29.24%
9	#1#=7	\$1,646,152.50	75.57%	1740	\$3,294.09	(\$4,120.61)	\$1,483.03	0.8	2.5	(\$63,800.00)	-29.89%
10	#1#=7.5	\$1,639,317.50	75.57%	1740	\$3,290.90	(\$4,127.77)	\$1,478.86	0.8	2.5	(\$63,800.00)	-31.76%
11	#1#=8	\$1,662,130.00	75.57%	1740	\$3,294.71	(\$4,084.91)	\$1,492.21	0.8	2.5	(\$63,800.00)	-29.42%
12	#1#=8.5	\$1,683,205.00	75.57%	1740	\$3,296.62	(\$4,041.24)	\$1,504.32	0.8	2.5	(\$63,800.00)	-29.42%
13	#1#=9	\$1,681,055.00	75.57%	1740	\$3,296.62	(\$4,046.29)	\$1,503.09	0.8	2.5	(\$63,800.00)	-29.42%
14	#1#=9.5	\$1,681,055.00	75.57%	1740	\$3,296.62	(\$4,046.29)	\$1,503.09	0.8	2.5	(\$63,800.00)	-29.42%
15	#1#=10	\$1,702,317.50	75.59%	1741	\$3,305.14	(\$4,035.06)	\$1,513.30	0.8	2.5	(\$63,800.00)	-29.42%
16	#1#=10.5	\$1,702,317.50	75.59%	1741	\$3,305.14	(\$4,035.06)	\$1,513.30	0.8	2.5	(\$63,800.00)	-29.42%
17	#1#=11	\$1,702,317.50	75.59%	1741	\$3,305.14	(\$4,035.06)	\$1,513.30	0.8	2.5	(\$63,800.00)	-29.42%
18	#1#=11.5	\$1,702,317.50	75.59%	1741	\$3,305.14	(\$4,035.06)	\$1,513.30	0.8	2.5	(\$63,800.00)	-29.42%
19	#1#=12	\$1,701,242.50	75.59%	1741	\$3,305.14	(\$4,037.59)	\$1,512.69	0.8	2.5	(\$63,800.00)	-29.42%
20	#1#=12.5	\$1,701,242.50	75.59%	1741	\$3,305.14	(\$4,037.59)	\$1,512.69	0.8	2.5	(\$63,800.00)	-29.42%
21	#1#=13	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
22	#1#=13.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
23	#1#=14	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
24	#1#=14.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
25	#1#=15	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%

Optimization Complete.  
0:30:34 elapsed since start of optimization

(Double-click on a column to sort results by that metric)

Save to File    OK    Print    Abort

## Short Stop Optimization

Optimization Results											
	Parameters	Profit/Loss	Accuracy	Num. Trades	Avg. Win	Avg. Loss	Avg. Trade	Win/Loss Ratio	Profit Factor	Max. Drawdown	Max. DD %
1	#1#=3	\$1,690,942.50	75.66%	1742	\$3,310.41	(\$4,061.01)	\$1,516.22	0.8	2.5	(\$66,137.50)	-25.39%
2	#1#=3.5	\$1,706,190.00	75.68%	1739	\$3,310.67	(\$4,045.47)	\$1,521.34	0.8	2.5	(\$69,262.50)	-25.65%
3	#1#=4	\$1,697,897.50	75.68%	1739	\$3,313.08	(\$4,070.07)	\$1,517.18	0.8	2.5	(\$63,800.00)	-25.91%
4	#1#=4.5	\$1,715,347.50	75.72%	1738	\$3,315.59	(\$4,043.36)	\$1,528.78	0.8	2.6	(\$63,800.00)	-26.19%
5	#1#=5	\$1,722,352.50	75.80%	1740	\$3,309.87	(\$4,045.84)	\$1,530.12	0.8	2.6	(\$63,800.00)	-26.55%
6	#1#=5.5	\$1,717,852.50	75.80%	1740	\$3,309.87	(\$4,056.53)	\$1,527.54	0.8	2.6	(\$63,800.00)	-26.90%
7	#1#=6	\$1,714,377.50	75.80%	1740	\$3,309.87	(\$4,064.79)	\$1,525.54	0.8	2.6	(\$63,800.00)	-27.13%
8	#1#=6.5	\$1,698,567.50	75.62%	1743	\$3,300.26	(\$4,042.74)	\$1,509.80	0.8	2.5	(\$63,800.00)	-29.42%
9	#1#=7	\$1,698,567.50	75.62%	1743	\$3,300.26	(\$4,042.74)	\$1,509.80	0.8	2.5	(\$63,800.00)	-29.42%
10	#1#=7.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
11	#1#=8	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
12	#1#=8.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
13	#1#=9	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
14	#1#=9.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
15	#1#=10	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
16	#1#=10.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
17	#1#=11	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
18	#1#=11.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
19	#1#=12	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
20	#1#=12.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
21	#1#=13	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
22	#1#=13.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
23	#1#=14	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
24	#1#=14.5	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%
25	#1#=15	\$1,705,580.00	75.59%	1741	\$3,305.35	(\$4,028.03)	\$1,515.18	0.8	2.5	(\$63,800.00)	-29.42%

Optimization Complete.  
0:30:10 elapsed since start of optimization

[Double-click on a column to sort results by that metric]

### Win/Loss Streak – Adaptive System

So while I may have removed the adaptive system in regards to the merged signal, I did discover several great improvements by adding in an adaptive batch exit system and adaptive contract sizing system based on win/loss streaks. Below are the win/long streaks of the default MVS with 5 batch exits, holding two batches until reversal for longs and holding all short positions (no batch exits) until reversal.

<b>WIN STREAKS</b>	<b>LOSS STREAKS</b>
1. 155	1. 208
2. 71	2. 60
3. 40	3. 29
4. 16	4. 11
5. 21	5. 4
6. 3	6. 1
7. 5	7. 1
8. 2	8. 1
9. 0	9. 1
10. 1	
11. 1	

Let's start with loss streaks. The system took an overall loss on a trade only once before having a profitable trade 208 times. Then it took a loss on two trades in a row only 60 times before having a profitable trade. That means it is 4x more likely that if it suffers two losses in a row, the next trade will be profitable than if it had suffered just one loss so we can adjust our exit system to take advantage of this. If you look at the next loss streak of 3 losses in a row, you will see it is again twice as likely to be profitable on the next trade as just two losses in a row. So what I did was perform a bunch of different optimization runs adjusting batch sizes, batches to hold on the next trade until reversal (only for longs as we already determined we should always hold short positions until reversal) and also adjusting contract size.

I discovered three things.

1. Adjusting batch sizes based on loss streaks did not result in any improvements.
2. Increasing batches we should hold until reversal did increase profit while keeping largest loss and MDD the same
3. Adjusting contract sizes based on loss streaks greatly improved profit while again, not increasing largest loss or MDD

So the settings I settled on for loss streaks are the following (assuming we are only trading 5 contracts but it does adjust dynamically if you are trading additional contracts). Each number indicates the number of losses in a row and the adjustment made. The adjustments for longs and shorts are different but we are not keeping track of long loss and short loss streaks separately so the adjustment is based on whatever rotation, either long or short, the system is on at that point in the loss streak.

## Loss Streak Adjustments

1. Long: Add 2 contracts to base trade size and increase batches to hold until reversal from 2 to 3  
Short: Add 2 contracts to base trade size
2. Long: Add 3 contracts to base trade size and increase batches to hold until reversal from 3 to 5  
Short: Add 3 contracts to base trade size
3. Long: Add 4 contracts to base trade size and keep batches to hold until reversal at 5  
Short: Add 4 contracts to base trade size
4. Long: Add 5 contracts to base trade size and keep batches to hold until reversal at 5  
Short: Add 5 contracts to base trade size

Now for win streak adjustment, you can also see a similar trend where the more wins the system has in a row, the more likely it becomes that the next trade will be a loss. However, after many optimization runs I realized that you want to be more careful with adjustments on win streaks as you want to allow the program to make as much profit as possible when it gets on a roll so decreasing contracts to trade or batches to hold until reversal can drop the profit by a lot. For instance, there were cases where it had up to 11 wins in a row so if we began decreasing contracts after the first win and continuing until we were only trading one contract, we are missing out on a lot of profit.

Therefore, I discovered the following.

1. After the system has two wins in a row, you will begin to decrease profit and actually increase MDD if you continue to decrease trade size.

This makes sense as if you sum all of the win streaks after 2 wins in a row, you will see it is actually more likely to continue its winning streak than taking a losing trade. The same holds true if you sum all of the win streaks after 1 win in a row but not by as large of a margin.

2. You will again decrease profit and increase MDD if you continue to decrease the batches to hold until reversal.

The way I think of it is this. The system has to get over a hump of a certain number of wins in a row and if it does this without taking a losing trade, it is more likely to continue its winning streak.

So the best adjustments I determined are below. If Earik was to review this, he may consider this over-optimization but these settings are very easy to adjust in the code. In fact, you can disable win streak adjustment entirely in the inputs if you think this adjustment is to static or targeted.

## Win Streak Adjustment

1. Long: No adjustments  
Short: No adjustments
2. Long: Decrease base trade size by 1 and decrease batches to hold until reversal to 1  
Short: Decrease base trade size by 1
3. Long: Decrease batches to hold until reversal to 0 (this means it gets out of one contract on each profitable trade for 5 trades)  
Short: No adjustments
4. Long: Reverts back to default trade size and batches to hold long  
Short: Reverts back to default trade size

For anything longer 3 win streaks, no adjustments are made.

The result is that we are decreasing our risk slightly if we have two winning trades in a row and then just decreasing our risk slightly more if we have three winning trades in a row as these are the two points in the win streak where there is the greatest increase of chance of the system taking a loss on the next trade. Once it is past three winning trades in a row, it reverts back to its default trade size and batches to hold until reversal to squeeze the most profit out of the systems longer winning streaks. Over 19 years of backtesting, this did not increase largest loss or MDD and while there is no guarantee it will not do so in the future, these settings are again easy to change and re-optimize if we discover this is over-optimized.

To show you the difference, here are two screenshots of the backtesting summary. The first is with no win/loss streak adjustment. The second is with the settings described above.

## No Adjustment

System Report

@ES#C (Daily) [@ES#C\_Daily] (9/9/1997 - 12/19/2016) Print Done

Summary | Trade by trade | Equity Curve | Annual Results | Monthly Results

Total Profit: \$1,425,847.46  
Long Profit: \$820,147.49  
Short Profit: \$605,699.97

Accuracy: 66.10%  
Winning Trades: 3946  
Losing Trades: 2024  
Total Trades: 5970

Avg. Win: \$778.14  
Avg. Loss: (\$812.59)  
Avg. Trade: \$238.84  
Win/Loss Ratio: 1.0

Largest Win: \$23,937.50  
Largest Loss: (\$40,125.00)  
Longest Winning Streak: 80 trades  
Longest Losing Streak: 20 trades  
Maximum Shares/Contracts Held: 5

Gross Profit: \$3,070,524.99  
Gross Loss: (\$1,644,677.52)  
Profit Factor: 1.9  
Annual Return: 13.46%

Max Drawdown: (\$63,712.50)  
Max Drawdown Percent: -26.71%  
Max Drawdown Date: 8/24/2015 1314  
Max Drawdown Percent Date: 8/17/1998 1314  
Longest Time Underwater: 342 bars

## With Adjustment

System Report☐ ☒ ✕

@ES#C (Daily) [@ES#C\_Daily] (9/9/1997 - 12/19/2016)PrintDone

SummaryTrade by tradeEquity CurveAnnual ResultsMonthly Results

Total Profit: \$1,724,282.50  
Long Profit: \$948,525.00  
Short Profit: \$775,757.50

Accuracy: 67.14%  
Winning Trades: 4504  
Losing Trades: 2204  
Total Trades: 6708

Avg. Win: \$754.85  
Avg. Loss: (\$760.23)  
Avg. Trade: \$257.05  
Win/Loss Ratio: 1.0

Largest Win: \$33,512.50  
Largest Loss: (\$40,125.00)  
Longest Winning Streak: 83 trades  
Longest Losing Streak: 29 trades  
Maximum Shares/Contracts Held: 10

Gross Profit: \$3,399,822.50  
Gross Loss: (\$1,675,540.00)  
Profit Factor: 2.0  
Annual Return: 14.58%

Max Drawdown: (\$63,737.50)  
Max Drawdown Percent: -34.04%  
Max Drawdown Date: 4/1/2015 1314  
Max Drawdown Percent Date: 8/17/1998 1314  
Longest Time Underwater: 298 bars

## Final Notes

Adding an entry filter was explored and while it did increase the accuracy to greater than 75% in some cases, it decreased overall profitability and surprisingly, increased the MDD. If it did not increase the MDD, a filter would be a good idea as it did help to flatten the equity curve but unless a filter is able to beat this current systems Profit per Unit of Risk score of 22.7, I have decided not to include it.

Entry filters explored so far are:

1. Price in relation to EMA
2. Fast EMA and Slow EMA
3. Price in relation to AMA
4. Fast AMA and Slow AMA

I also experimented with using an ATR stop system that allowed the system to re-enter a trade if the signal hit a certain threshold. So let's say we got stopped out of a long position and the signal was showing +4. Maybe we would allow the program to re-enter a long trade if the signal hit +9 which would indicate and the most bullish signal possible. This did produce some interesting results and in one case decreased the MDD to \$50k BUT it also decreased profit by a large amount so the profit per unit of risk score was unacceptably low. The current settings listed at the top of this documentation has the greatest PPUR score of any optimization run.

Due to this, I left the system as is so if it gets stopped out, it cannot enter the position in the same direction and must wait for the reversal signal.

Lastly, I tried one more stop strategy that I ultimately removed as well where the ATR stop would only be enabled after a certain number of losses or wins in a row.

All system reports should be in same folder as this document.