Trading DIA ETF 5min Bars Using the Repeated Median Velocity Algorithm
Walk Forward in-sample 20 Trading weekdays and out-of-sample 1 Trading weekday
01/31/2024 to 09/05/2025

Disclaimer

The strategies, methods and indicators presented here are given for educational purposes only and should not be construed as investment advice. Be aware that the profitable performance presented here is based upon hypothetical trading with the benefit of hindsight and can in no way be assumed nor can it be claimed that the strategy and methods presented here will be profitable in the future or that they will not result in large losses

In previous working papers we examined a trading system that used the velocity of prices fit by a least squares straight line through "N" past prices, to determined buy and sell points. The reasoning behind this type of system was to only trade when the straight-line slope or velocity was above a certain threshold. Many times, during the day prices meander around without a notable trend. At these times we do not wish to trade because of the whipsaws losses that occur from this type of price action. When a price trend finally starts, the velocity of that price trend moves above some minimum threshold value. Thus, the velocity system would only issue a trade when certain velocity barriers were crossed.

The Least Squares polynomial is determined by minimizing the sum of the squares of the difference between the N prices and the value of the polynomial line.

$$err^2(t) = [Price(t)-(a+b*t)]^2 \text{ = error squared}$$

$$\text{Minimize}(a,b) \sum_{t=1}^{t=N} err^2(t)$$

This mathematical technique has an exact solution and dates back to Gauss in the 1800's.

Recently much work has been done in what is called robust regression and outlier detection techniques, Ref [1]. Robust regression techniques are now defined by a measure called the "breakdown point". The breakdown point is loosely defined as the smallest amount of bad data points that can cause the regression coefficient solutions to take on values some distance from their true values. Unfortunately, the Least Squares technique has a breakdown point of 1/N. In other words, only one bad data point can significantly change the computation of the velocity or slope of a straight line. The median of a set of numbers has a breakdown point of 50%. This is because when 50% of the numbers are bad then there is no way of telling which are the bad numbers and which are the good numbers. 50% is the highest breakdown point.

The least absolute deviation (LAD) regression estimator from Ref [1] is

$$\text{Minimize}(a,b) \sum_{i=1}^{i=N} \text{absolute value [err(i)]}$$

and has a breakdown point of 29.8% . For the LAD this means around ¼ of the price points can be bad before the computations of a and b become erroneous. Siegel Ref [2], in his paper "Robust regression using repeated medians", introduced a technique for finding the slope that has a 50% breakpoint. The repeated median is also described in Ref [1].

While the repeated median technique may sound complicated it is quite easy to compute. Here's how. For demonstration purposes let's suppose we have 15 data points on an x, y graph such that,

X	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Y	1	2	10	4	5	6	7	8	9	18	11	12	13	18	15	20

We've added two bad Y points at X positions 3,10, 14 and 16. To calculate the repeated median slope we would take the slope of every pair of y values and then find the median of all the pairs of slopes. For this example, we would take

slope	**1**	**y(2)-y(1)/(2-1) =**	**1.00**
slope	**2**	**y(3)-y(1)/(3-1)=**	**4.50**
slope	**3**	**y(4)-y(1)/4-1)=**	**1.00**
slope	**4**	**y(5)-y(1)/(5-1)=**	**1.00**
slope	**5**	**y6)-y(1)/(6-1)=**	**1.00**
slope	**6**	**y(7)-y(1)/(7-1)=**	**1.00**
slope	**7**	**y(8)-y(1)/(8-1)=**	**1.00**
slope	**8**	**y(9)-y(1)/(9-1)=**	**1.00**
slope	**9**	**y(10)-y(1)/(10-1)=**	**1.89**
slope	**10**	**y(11)-y(1)/(11-1)=**	**1.00**
slope	**11**	**y(12)-y(1)/(12-1)=**	**1.00**
slope	**12**	**y(13)-y(1)/(13-1)=**	**1.00**
slope	**13**	**y(14)-y(1)/(14-1)=**	**1.31**
slope	**14**	**y(15)-y(1)/(15-1)=**	**1.00**
slope	**14**	**y(16)-y(1)/(16-1)=**	**1.27**
		Median =	**1.00**

The median slope of the above is 1. The above process is repeated for:
(y(2)-y(i))/(2-i), i=1 to 15 i≠2,
(y(3)-y(i))/(3-i), i=1 to 15 i≠3,
……..
(y(16)-y(i))/(16-i), i=1 to 16 i≠16.

The final slope is then the **median of all the medians calculated above**. While the repeated median looks redundant because the very first calculation produced the correct slope, price data is not so nicely distributed as our example and the extra calculations are needed to assure that the outliers are eliminated.

The mathematical formula for the above is

$$\text{Slope}(t) = \underset{i=1 \text{ to } N}{\text{median}_i} \{ \underset{j=1 \text{ to } N}{\text{median}_{i \neq j}} [\text{price}(t)-\text{price}(t-i))/(i-j)] \}$$

Figure 1 below shows a plot of the x,y numbers above with the repeated median line and the least squares line on the graph. Notice how the bad points draw the least squares line towards them while the repeated median line is completely unaffected by the outliers. The least Squares line is given by the formula **y=-0.65 + 1.1074*x** . The true line is given by the formula **y=x** . From this simple example we can observe how noise has distorted the least squares estimates of **a** and **b, where y=a+bx**.

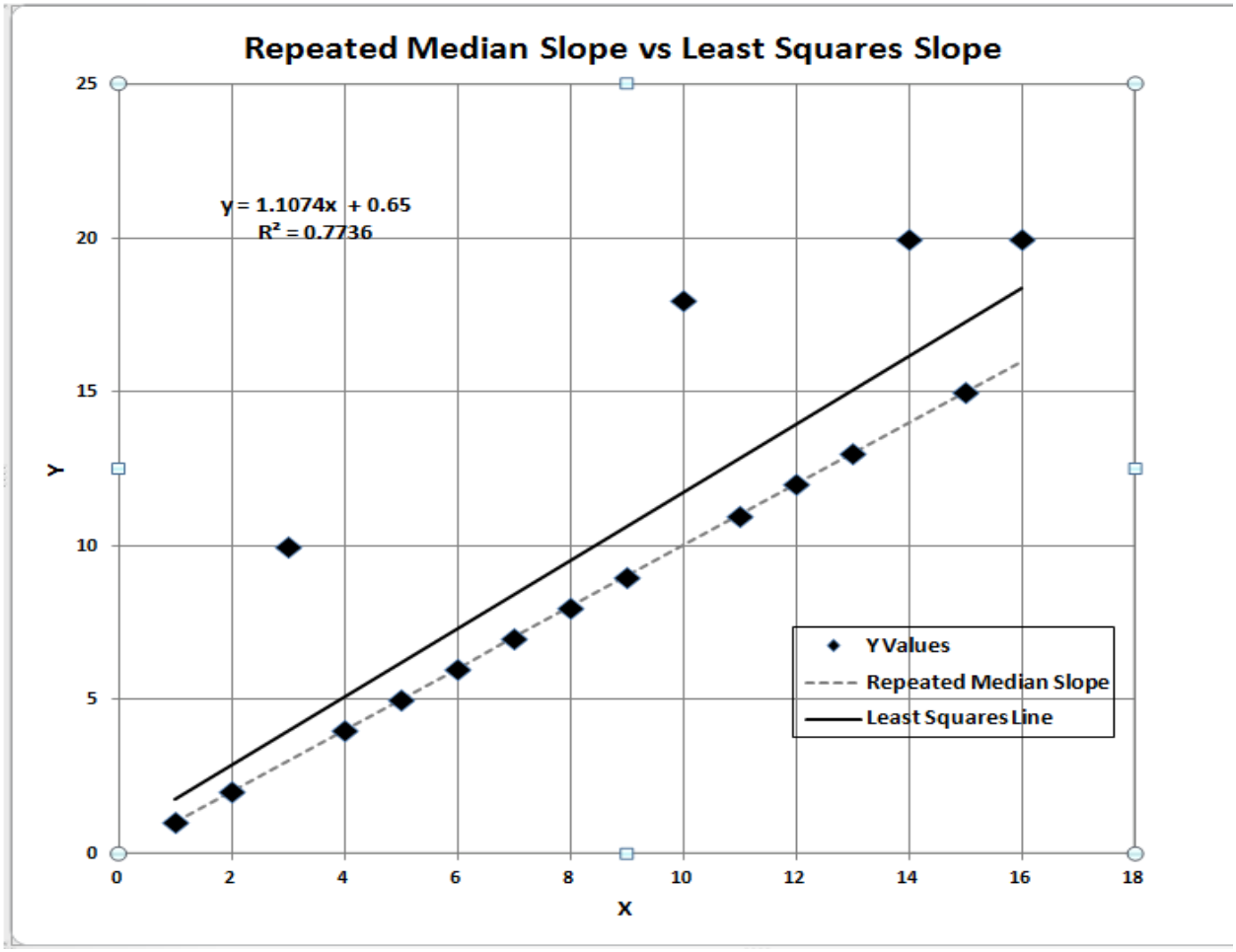

Figure 1 Repeated Median Slope vs Least Squares Slope.

The Repeated Median Velocity (RMedV) System Defined

Here we will use the repeated median slope to create a trading system. For a straight line the velocity is equal to the slope. The repeated median velocity, also called the **robust velocity,** has the advantage that it is a natural random price noise inhibitor. We can create a system such that unless the repeated median velocity using N past price bars is greater than some threshold value we will not buy or sell. A large percentage of price movements are just noise which generates a lot of back-and-forth movements of small magnitudes. This back-and-forth movement creates many false buy and sell signals. However, using the repeated median velocity over N past prices, we will attempt to filter out many of the small price noise movements by requiring that the repeated median velocity to be greater than some threshold before we act.

At each price bar we calculate the repeated median velocity (**RMedV**) from the formula above. When the velocity is greater than the threshold amount ***vup*** we will go long. When the velocity is less than the threshold amount **-** ***vdn*** we will go short.

The Repeated Median Velocity Trading Strategy

Buy Rule:

IF RMedV is greater than or equal to the threshold amount ***vup and RMedV[1] is less than vup*** than buy at the market.

Sell Rule:
IF RMedV is less or equal to the threshold amount ***-vdn and RMedV[1] is greater than -vdn*** then sell at the market.

Where RMedV[1] is the RMedV on the previous bar.

Intraday Bars Exit Rule:
Close the position at 1555 EST. No trades will be carried out overnight.

Testing the Repeated Median Velocity System (RMedV)
Using Walk Forward Optimization
There are three strategy inputs to determine:

1. ***N***, the lookback period to calculate the **RMedV.**
2. ***vup***, the threshold amount that RMedV must be greater than to issue a buy signal
3. ***vdn***, the threshold amount that RMedV must be less than to issue a sell signal

As mentioned, to test this Strategy we will use five-minute bar prices of the DIAs ETF traded on the NYSE for the 402 trading days from January 31, 2024, to September 9, 2025. However, The Walk Forward Input Explorer will only analyses data from 1/31/2024 to 6/13/2025. 6/16/2025 to 9/5/2025 will be withheld from the WFINP to see how the filter applied to the 1/31/2024-6/13/2025 data did in the next 60 trading days , approximately 3 months, of trading days, of 6/16/25 to 9/5/25. We will test the RMedV strategy with the above DIA ETF 5 min bars on a ***walk forward basis***, where the in-sample (***IS***) will be 20 trading weekdays and the out-of-sample (***OOS***) will be the next trading weekday following as will be described below.

What Is Walk Forward Optimization with In-Sample Section and Out-Of-Sample Sections?

Whenever we do a TradeStation or Multicharts (TS/MC) optimization on many different strategy inputs, TS/MC generates a report of performance metrics (total net profits, number of losing trades, etc.) vs these different strategy inputs. If the report is sorted on say the total net profits(***tnp***) performance metric column then the highest ***tnp*** would correspond to a certain set of inputs. This is called an ***in-sample (IS) section***. If we choose a set of strategy inputs from this report based upon some performance metric, we have no idea whether these strategy inputs will produce the same results on future price data or data they have not been tested on. Price data that is not in the in-sample section is defined as ***out-of-sample data***. Since the performance metrics generated in the in-sample section are mostly due to “curve fitting” or "data mining" it is important to see how the strategy inputs chosen from the in-sample section perform on out-of-sample data.

What do we mean by ***“curve fitting” or data mining?*** As a simple example, suppose you were taking the subway to work. In the subway car you are in, suppose you counted the number of blond women in that car and suppose the percent of blond women vs all other women hair colors was 80%. Being that you cannot observe what is in the other subway cars, you would assume that all the other subway cars and perhaps all women had the same percentage of blond hair. This observation was due to chance. That is an example of curve fitting. The same goes for combinatorial searches. You are observing results from a finite sample of data without knowing the data outside the sample you examined.

Walk forward analysis attempts to minimize the curve fitting of price noise by using the law of averages from the Central Limit Theorem on the out-of-sample performance. In walk forward analysis the data is broken up into many in-sample and out-of-sample sections. Usually for any strategy, one has some performance metric selection procedure, which we will call a ***filter,*** used to select the strategy input parameters from the optimization run. For instance, a ***filter*** example might be all cases that have a profit factor (PF) greater than 1 and less than 3. For the number of cases left, we might select the cases that had the best percent profit. This procedure would leave you with one case in the in-sample section output and its associated strategy input parameters. Now suppose we ran

our optimization on each of our many in-sample sections and applied our ***filter*** to each in-sample section output. We would then use the strategy input parameters found by the ***filter*** in each in-sample section on the out-of-sample section immediately following that in-sample section. The input parameters found in each in-sample section and applied to each out-of-sample section would produce independent net profits or losses for each of the out-of-sample sections. Using this method, we now have "x" number of independent out-of-sample section profit and losses from our ***filter***. If we take the average of these out-of-sample section net profits and losses, then we will have an estimate of how our strategy will perform on average. Due to the Central Limit Theorem, as your sample size increases, the spurious noise results in the out-of-sample section performance tend to average out to zero in the limit, leaving us with what to expect from our strategy and filter. ***Mathematical note: This assumption assumes that the out-of-sample returns are from probability distributions that have a finite variance*****.**

Why use the walk forward technique? Why not just perform an optimization on the whole price series and choose the input parameters that give the best total net profits or profit factor or some other performance metric? Surely the price noise cancels itself out with such a large number of in-sample prices and trades. Unfortunately, nothing could be farther from the truth! Optimization is a misnomer and should really be called combinatorial search. As stated above, whenever we run a combinatorial search over many different combinations of input parameters on noisy data on a fixed number of prices, ***no matter how many***, the best performance parameters found are guaranteed to be due to ***"curve fitting"*** the noise and signal. The price series that we trade consists of random spurious price movements, which we call noise, and repeatable price patterns (*if they exist*). When we run, for example, 5000 different inputs parameter combinations, the best performance parameters will be from those strategy input variables that are able to produce profits from the price pattern ***and*** the random spurious movements While the price patterns will repeat, the same spurious price movements will not. If the spurious price movements that were captured by a certain set of input parameters were a large part of the total net profits, as they are in real intraday price series, then choosing these input parameters will produce losses when traded on future data. These losses occur because the spurious price movements will not be repeated in the same way. This is why strategy optimization or combinatorial searches, also called back testing, with no out-of-sample testing cause loses when traded in real time from something that looked great in the in-sample section.

To gain confidence that our input parameter selection method or filter, using the optimization output of the in-sample data, will produce profits, we must test the input parameters we found in the in-sample section on out-of-sample data. In addition, we must perform the in-sample/out-of-sample analysis many times. Why not just do the out-of-sample analysis once or just 10 times? Well just as in Poker or any card game, where there is considerable variation in luck from hand to hand, walk forward out-of-sample analysis give considerable variation in out-of-sample profit "luck". That is, by pure chance we may have chosen some input parameter set that did well in the in-sample section data ***and*** the out-of-sample section data. In order to minimize this type of "luck", statistically, we must repeat the walk forward out-of-sample (**OOS**) analysis over many (>50) in-sample/out-of-sample sections and take an average over all out-of-sample sections. This average gives us an expected out-of-sample return and a standard deviation of out-of-sample returns which allows us to statistically estimate the expected equity and its range for N out-of-sample periods in the future

Finding The RMedV Strategy Parameters Using Walk Forward Optimization

There are three strategy parameters to find*, N, vup, vdn.*

For the test data we will run the TS or MC optimization engine on **DIA** 5 min price bars from 1/31/2024 to 9/5/2025 with the below optimization ranges for the RMedV strategy inputs. This will create **402, 20 weekday in-sample periods, each followed by a 1 day out-of-sample period** (See Figure 1 for the in-sample/out-of-sample periods). The days are weekdays only. Weekdays when the OOS falls on an exchange holiday or partial days are eliminated. Holidays that fall on a weekday create a 19-day ***IS***. All other ***IS*** periods consist of 20 trading weekdays. The optimization ranges are:

1. **N from 4 to 20 in steps of 1.**
2. **vup from 0.25 to 3.5 steps of 0.25**

3. **vdn from 0.25 to 3.5 in steps of 0.25**
4. **Mult = 2.3, iNorm=1 (See Appendix, the Normalization Multiplier)**

The above n, vup, vdn will produce 3342 different input combinations or cases of the strategy input parameters for each of the 402 in-sample/out-of-sample files for the 19 months of 5 min bar DIA data.

Finding the Best Set of Strategy Inputs to use with an in-sample Metric Filter.

The PWFO generates a number of performance metrics in the in-sample section. (Please see https://meyersanalytics.com/Walk-Forward-Optimization for a listing of these performance metrics).The question we are attempting to answer statistically, is which performance metric or combination of performance metrics (which we will call a ***filter***) applied to a given set of strategy inputs in the ***in-sample*** section will produce statistically valid profits in the sum of all out-of-sample sections. In other words, we wish to find the best set of strategy inputs ***with a metric filter applied*** in each **in-sample** section that gives the "best" total out-of-sample results over all out-of-sample sections. This means if we applied our ***metric filter*** to the strategy inputs chosen in the in-sample section, we would ***only trade using those set of strategy inputs*** in the next out-of-sample section if the in-sample ***metric filter*** satisfied our criteria. ***Else no trades would be made*** in the next out-of-sample section.

The Walk Forward Strategy – Strategy Inputs with Metric Filters Explorer.

We wish to find ***one*** set of strategy inputs that we can trade in every out-of-sample section, but we will only trade that set of strategy inputs in the out-of-sample section if and only if they satisfy our in-sample ***metric-filter***. Else we will not trade the next out-of-sample section. In this paper the in-sample section is 20 trading days, and the out-of-sample section is the next trading day. After running the PWFO on the in-sample data, we examine the in-sample metric filter that we chose. If the strategy inputs we selected satisfy the in-sample metric filter requirements then we use those strategy inputs to trade the next day. If the strategy inputs do not satisfy the in-sample metric filter we do not trade the next day.

Let us define the in-sample ***metric-filter*** we will use here: in-sample (IS) Profit Factor (**PF≤ x**) and/or IS Losers in a row (**lr ≤ y)**,and/or IS equity curve straight line correlation coefficient **R2(r^2) ≤z)**. That is **PF ≤ x and/or lr≤ y and/or R2 ≤ z.**

What we are going to do here is look at every combination in the in-sample section of each **strategy input** with **PF ≤ x and/or lr<y and/or R2 ≤ z**. This will produce seven **strategy input|metric-filter** combinations:

1. **strategy input|PF ≤ x, lr≤y, R2 ≤ z|**
2. **strategy input|PF ≤ x, lr ≤ y|**
3. **strategy input|PF ≤ x, R2 ≤ z|**
4. **strategy input|PF ≤ x |**
5. **strategy input|LR ≤ y, R2 ≤ z|**
6. **strategy input|lr ≤ x|**
7. **strategy input|R2 ≤ z|**
8. **strategy input – we also examine inputs with no filter**

If the **strategy input|metric-filter** satisfies **the metric-filte**r condition in the in-sample section, then we will use those strategy inputs to trade in the out-of-sample section. If not, then there will be no trades in the out-of-sample section.

We will look at all **IS metric-filter** combinations of **PF≤2 to 6 step 1, LR≤3,5 step 2 and R2≤50 to 70 step 10.** We will also look at the strategy input with no metric-filter. With 3342 different strategy input combinations this will give us 199919 **strategy input|metric-filter** combinations. Each one of these 199919-strategy **input|metric-filter** combinations will be applied to each in-sample section and their out-of-sample performance will be tabulated for all 342 PWFO files from 1/31/24-6/10/25. Remember that the pwfo files from 6/11/25-9/5/25 were withheld from the Walk Forward Input Explorer (WFINP) analysis.

Below is a snippet of the output from a run of all 199919 combinations sorted by **tONP = total OOS net profit for each strategy input|metric-filter** combination. ***The column definitions are defined in Figure 3 below***. This example shows a partial output file from the WFINP program run on the PWFO files generated with the RMedV that was run on 100 shares of DIA ETF 5-minute bars 342 days from 12/31/2024 to 6/9/2025. The in-sample (IS) period is 20 trading weekdays, and the out-of-sample (OOS) period is 1 trading weekday. This strategy was traded between 9am to 1600pm Exchange Time (EST).

From this run, we chose the filter on Row3 of the Figure below. That is,

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4|0.25|2.75|0|1555|2.3|pf<2|r2<50. This is constructed as follows. For the strategy inputs **4|0.25|2.75|0|1555|2.3|**only those in-sample sections that have a **pf ≤2** and **r2≤50** are used to trade in the following out-of-sample sections. If the in-sample pf > 2 and or r2>50 then the out-of-sample section following the in-sample section ***is not*** traded.

1	DIA5mRMedV20x1dxof	s01/31/24	e06/10/25	#342	AnyTnp	#60					ISnt2			a(4.7)	s11.6						c=$4				f199919
2	N|vup|vdn|xop|xt|mult|<PF<LR<R2	toGP	tONP	aoGP	aoTr	ao#T	#	%P	oW|oL	%Wtr	std	skew	kur	t	LLtr	LLp	eqDD	wpr	lpr	V20	KTau	eqR2	Blw	tkr|be	Prob
3	4|0.25|2.75|0|1555|2.3|pf<2|r2<50	15252	13500	62	34.8	1.8	246	56	1.52	51	278	0.837	10.16	3.5	-600	-1205	-1451	8	6	102	94	95	26	1032	1.49E-07
4	4|0.25|2.75|0|1555|2.3|pf<4|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
5	4|0.25|2.75|0|1555|2.3|pf<3|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
6	4|0.25|2.75|0|1555|2.3|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
7	4|0.25|2.75|0|1555|2.3|pf<5|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
8	6|1|2.25|0|1555|2.3|pf<2|r2<50	14618	13242	67	42.5	1.6	217	58	1.58	52	279	1.977	17.19	3.55	-533	-635	-1389	8	6	117	91	91	46	559	7.82E-09
9	6|0.25|2.25|0|1555|2.3|pf<5|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
10	6|0.25|2.25|0|1555|2.3|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
11	6|0.25|2.25|0|1555|2.3|pf<3|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
12	6|0.25|2.25|0|1555|2.3|pf<4|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
13	6|0.25|2.25|0|1555|2.3|pf<2|r2<50	14615	12907	58	34.2	1.7	250	57	1.51	50	285	2.402	23.16	3.24	-776	-921	-1231	10	7	116	94	93	26	798	6.31E-07
14	6|1|2.25|0|1555|2.3|pf<3|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
15	6|1|2.25|0|1555|2.3|pf<4|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
16	6|1|2.25|0|1555|2.3|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
17	6|1|2.25|0|1555|2.3|pf<5|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
18	12|0.75|2.5|0|1555|2.3|pf<2|r2<60	13735	12695	65	52.8	1.2	211	67	1.22	61	279	4.91	54.09	3.39	-646	-646	-880	17	6	100	94	86	25	874	1.20E-08

1	DIA5mRMedV20x1dxof	s06/11/25	e09/05/25	#60			
2	N|vup|vdn|xop|xt|mult|<PF<LR<R2	toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet
3	4|0.25|2.75|0|1555|2.3|pf<2|r2<50	1806	1558	29	1.3	48	15058
4	4|0.25|2.75|0|1555|2.3|pf<4|r2<50	1409	1157	22	1.3	49	14510
5	4|0.25|2.75|0|1555|2.3|pf<3|r2<50	1409	1157	22	1.3	49	14510
6	4|0.25|2.75|0|1555|2.3|r2<50	1409	1157	22	1.3	49	14510
7	4|0.25|2.75|0|1555|2.3|pf<5|r2<50	1409	1157	22	1.3	49	14510
8	6|1|2.25|0|1555|2.3|pf<2|r2<50	1069	829	18	1.3	45	14071
9	6|0.25|2.25|0|1555|2.3|pf<5|r2<50	579	255	7	1.4	60	13428
10	6|0.25|2.25|0|1555|2.3|r2<50	579	255	7	1.4	60	13428
11	6|0.25|2.25|0|1555|2.3|pf<3|r2<50	579	255	7	1.4	60	13428
12	6|0.25|2.25|0|1555|2.3|pf<4|r2<50	579	255	7	1.4	60	13428
13	6|0.25|2.25|0|1555|2.3|pf<2|r2<50	579	255	7	1.4	60	13162
14	6|1|2.25|0|1555|2.3|pf<3|r2<50	987	735	16	1.3	47	13600
15	6|1|2.25|0|1555|2.3|pf<4|r2<50	987	735	16	1.3	47	13600
16	6|1|2.25|0|1555|2.3|r2<50	987	735	16	1.3	47	13600
17	6|1|2.25|0|1555|2.3|pf<5|r2<50	987	735	16	1.3	47	13600
18	12|0.75|2.5|0|1555|2.3|pf<2|r2<60	8	(180)	0	1.2	40	12515

This is the 2nd section from 6/11/25 to 9/5/25 which was not included in the Walk Forward Input Explorer(WFINP) run. This is how the filter found by the WFINP on the 1/31/2024-6/10/25 data performed on the next 60 trading days.

Bootstrap Probability of Filter Results.

Using modern "Bootstrap" techniques, we can calculate the probability of obtaining our filter's total out-of-sample ***net*** profits by chance. Here is how the bootstrap technique is applied. Suppose as an example, we have 500 files of in-sample/out-of-sample data. A mirror random filter is created. Instead of picking an out-of-sample net profit (OSNP) from a filter row as before, the mirror filter picks a ***random*** row's OSNP in each of the 500 files. We repeat this random picking in each of the 500 files 5000 times. Each of the 5000 mirror filters will choose a random row's OSNP of their own in each of the 500 files. At the end, each of the 5000 mirror filters will have 500 ***random*** OSNP's picked from the rows of the 500 files. The sum of the 500 random OSNP picks for each mirror filter will generate a random total out-of-sample net profit (toNP) or final random equity. The average and standard deviation of the 5000-mirror filter's different random toNPs will allow us to calculate the chance probability of our above chosen filter's toNP. Thus, given the mirror filter's bootstrap random toNP average and standard deviation, we can calculate the probability of obtaining our chosen filter's toNP by pure chance alone. Figure 3 lists the 5000-mirror filter's bootstrap average for our 342 out-of-sample files of **-$4.7** with a bootstrap standard deviation of **$11.6**. (Side Note. The average is the average per out-of-sample period. So, the average for the random selection would be the random toNP/342 and the average for the filter would be the filter toNP/# of OOS periods traded or

13500/246=54.88). The probability of obtaining our filters average daily net profit **of 54.88** is **$1.45x10^{-7}$** which is **5.14** standard deviations from the bootstrap average. For our filter, in Row3 above, the expected number of cases that we could obtain by pure chance that would match or exceed **$54.88** is $[1-(1-\mathbf{1.45x10^{-7}})^{199919}]$ ~= **$199919*1.45x10^{-7} = 0.029$** where **199919** is the total number of different filters we looked at in this run. This number is much less than one, so it is improbable that our result was due to pure chance.

Results

Figure 1 presents a graph of the equity curve generated by using the filter on the 402 days from 1/31/24 to 9/5/25. The equity curves are plotted from Equity and Net Equity columns in Table 1. Plotted on the equity curves is the 2nd Order Polynomial curve. The blue line is the equity curve without commissions and the red dots on the blue line are new highs in equity. The brown line is the equity curve with commissions and the green dots are the new highs in net equity. The grey line is the DIA Daily Closing prices superimposed on the Equity Chart. The vertical red dotted line separates the non-Included in the WFINP run 06/11/25-9/5/25

Figure 2 presents a plot of the RMedV Strategy buy/sells and the RMedV Indicator on the DIA 5min bars for 8/1/2025 - 8/11/2025.

Table 1 below presents a table of the 405 in-sample and out-of-sample windows, the **Filter** selected in-sample strategy inputs and the daily out-of-sample profit/loss results using the filter described above.

Discussion of Strategy Performance

In Figure 3, Row3 of the spreadsheet filter output are some statistics that are of interest for our filter. An interesting statistic is **Blw**. **Blw** is the maximum number of days the OSNP equity curve failed to make a new high. **Blw** is **26** days for this filter. This means that 26 trading days were the longest time that the equity for this strategy failed to make a new equity high. **%Wtr** is the percentage of all OOS trades that were wins or positive. For this filter, the **%Wtr=51%**. **%P** is the % winning oos days, **%P=56%**. The average oos winning trade to the average oos losing trade ratio(**oW|oL**) was **1.52**. **wpr=8** is the maximum number of consecutive winning oos periods(days) in a row and **lpr=6** is the maximum number of consecutive losing oos periods(days) in a row. The Largest losing trade in the whole period was ($600) and the largest losing day was ($1250). The maximum drawdown during this period was ($1021).

In Figure 1, which presents a graph of the equity curve using the filter on the 342 trading days of out-of-sample data, plus the 60 trading days not included in the WFINP run. The equity curve follows the 2nd order polynomial trend line with an R^2 of 0.9986. The R^2 only dropped to 0.984 for the net equity curve.

Using this filter, the strategy was able to generate $13500 net equity after commissions of $0 (many brokers today don't charge commissions) and slippage of $4 trading 100 DIA ETF shares for 342 days. The period of time from 1/3/25 to 6/10/25 was a volatile down then up market, yet the RMedV strategy was able to adapt quite well.

In observing Table 1 we can see that this strategy and filter made trades from a low of no trades/day to a high of 15 trades/day (which occurred during the Trump "Liberation Day" week) with an average of 1.8 trades/day on the days it traded. For the no trade days, the strategy **input|filte**r in the in-sample section didn't satisfy the metric filter and no trades were made the next trading day. The **input|filter** traded 246 days out of the 342 days or about 72% of the time.

References

1. Rousseau, P.J., Leroy, A.M., (1987) "Robust Regression and Outlier Detection", New York, John Wiley & Sons.
2. Siegel, A.F. (1982), "Robust Regression using Repeated Medians." *Biometrika*. 69, pp242-244.

3. Efron, B., Tibshirani, R.J., (1993), “An Introduction to the Bootstrap”, New York, Chapman & Hall/CRC.

Figure 1 Graph of RMedV Strategy Out-Of-Sample Equity Applying the Walk Forward Filter Each Day on the in-sample section on DIA 5min Bar Prices 1/13/2024 to 9/5/2025

Note: The blue line is the equity curve without commissions and the red dots on the blue line are new highs in equity.
The brown line is the equity curve with commissions and the green dots are the new highs in net equity
The grey line is the DIA Daily Closing prices superimposed on the Equity Chart.
The vertical red dotted line separates the non-Included in the WFINP run 06/11/25-9/5/25

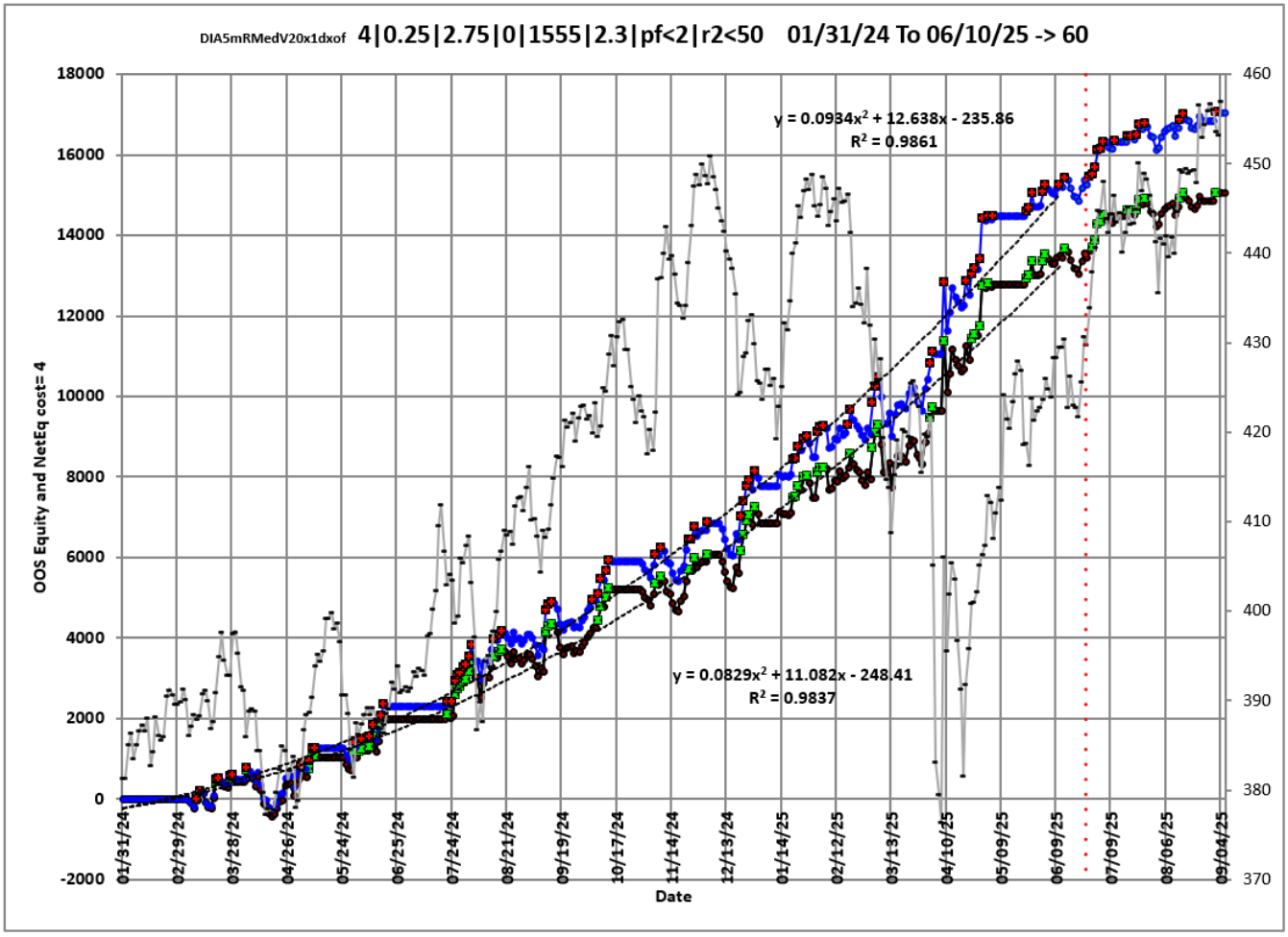

Figure 2 Walk Forward Out-Of-Sample Performance Summary for RMedV Strategy DIA 5-minute bar chart from 8/1/25 to 8/11/25

Figure 3 Partial output of the Walk Forward Strategy Inputs with Metric Filters (WFINP) DIA ETF 5 min bars Using The RMedV Strategy

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
1	DIA5mRMedV20x1dxof	s01/31/24	e06/10/25	#342	AnyTnp	#60					lSnt2			a(4.7)	s11.6						c=$4				f199919
2	N|vup|vdn|xop|xt|mult|<PF<LR<R2	toGP	tONP	aoGP	aoTr	ao#T	#	%P	oW|oL	%Wtr	std	skew	kur	t	LLtr	LLp	eqDD	wpr	lpr	V20	KTau	eqR2	Blw	tkr|be	Prob
3	4|0.25|2.75|0|1555|2.3|pf<2|r2<50	15252	13500	62	34.8	1.8	246	56	1.52	51	278	0.837	10.16	3.5	-600	-1205	-1451	8	6	102	94	95	26	1032	1.49E-07
4	4|0.25|2.75|0|1555|2.3|pf<4|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
5	4|0.25|2.75|0|1555|2.3|pf<3|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
6	4|0.25|2.75|0|1555|2.3|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
7	4|0.25|2.75|0|1555|2.3|pf<5|r2<50	15121	13353	61	34.2	1.8	249	56	1.51	51	277	0.845	10.21	3.46	-600	-1205	-1451	8	6	102	95	95	22	1183	2.62E-07
8	6|1|2.25|0|1555|2.3|pf<2|r2<50	14618	13242	67	42.5	1.6	217	58	1.58	52	279	1.977	17.19	3.55	-533	-635	-1389	8	6	117	91	91	46	559	7.82E-09
9	6|0.25|2.25|0|1555|2.3|pf<5|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
10	6|0.25|2.25|0|1555|2.3|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
11	6|0.25|2.25|0|1555|2.3|pf<3|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
12	6|0.25|2.25|0|1555|2.3|pf<4|r2<50	14897	13173	59	34.6	1.7	254	57	1.51	51	283	2.414	23.46	3.3	-776	-921	-1210	10	7	116	94	94	26	849	5.70E-07
13	6|0.25|2.25|0|1555|2.3|pf<2|r2<50	14615	12907	58	34.2	1.7	250	57	1.51	50	285	2.402	23.16	3.24	-776	-921	-1231	10	7	116	94	93	26	798	6.31E-07
14	6|1|2.25|0|1555|2.3|pf<3|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
15	6|1|2.25|0|1555|2.3|pf<4|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
16	6|1|2.25|0|1555|2.3|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
17	6|1|2.25|0|1555|2.3|pf<5|r2<50	14269	12865	64	40.7	1.6	222	58	1.54	52	281	1.871	16.81	3.41	-638	-638	-1389	9	6	117	91	90	46	489	3.53E-08
18	12|0.75|2.5|0|1555|2.3|pf<2|r2<60	13735	12695	65	52.8	1.2	211	67	1.22	61	279	4.91	54.09	3.39	-646	-646	-880	17	6	100	94	86	25	874	1.20E-08

	A	Z	AA	AB	AC	AD	AE
1	DIA5mRMedV20x1dxof	s06/11/25	e09/05/25	#60			
2	N|vup|vdn|xop|xt|mult|<PF<LR<R2	toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet
3	4|0.25|2.75|0|1555|2.3|pf<2|r2<50	1806	1558	29	1.3	48	15058
4	4|0.25|2.75|0|1555|2.3|pf<4|r2<50	1409	1157	22	1.3	49	14510
5	4|0.25|2.75|0|1555|2.3|pf<3|r2<50	1409	1157	22	1.3	49	14510
6	4|0.25|2.75|0|1555|2.3|r2<50	1409	1157	22	1.3	49	14510
7	4|0.25|2.75|0|1555|2.3|pf<5|r2<50	1409	1157	22	1.3	49	14510
8	6|1|2.25|0|1555|2.3|pf<2|r2<50	1069	829	18	1.3	45	14071
9	6|0.25|2.25|0|1555|2.3|pf<5|r2<50	579	255	7	1.4	60	13428
10	6|0.25|2.25|0|1555|2.3|r2<50	579	255	7	1.4	60	13428
11	6|0.25|2.25|0|1555|2.3|pf<3|r2<50	579	255	7	1.4	60	13428
12	6|0.25|2.25|0|1555|2.3|pf<4|r2<50	579	255	7	1.4	60	13428
13	6|0.25|2.25|0|1555|2.3|pf<2|r2<50	579	255	7	1.4	60	13162
14	6|1|2.25|0|1555|2.3|pf<3|r2<50	987	735	16	1.3	47	13600
15	6|1|2.25|0|1555|2.3|pf<4|r2<50	987	735	16	1.3	47	13600
16	6|1|2.25|0|1555|2.3|r2<50	987	735	16	1.3	47	13600
17	6|1|2.25|0|1555|2.3|pf<5|r2<50	987	735	16	1.3	47	13600
18	12|0.75|2.5|0|1555|2.3|pf<2|r2<60	8	(180)	0	1.2	40	12515

This is the 2nd section from 6/11/25 to 9/5/25 which was not included in the Walk Forward Input Explorer(WFINP) run. This is how the filter found by the WFINP on the 1/31/2024-6/10/25 data performed on the next 60 trading days.

The WFINP AVE File Output Cols are defined as follows.

Row 1 DIA5mRMedV20x1xoa is the PWFO output files abbreviation, First OOS Day End Date (1/31/24), Last OOS Day End Date (6/10/25), **Number of days** (#342) a=average of bootstrap random picks. **s**= standard deviation of bootstrap random picks. **f**=number of different filters examined. **c**= slippage and round-trip trade cost(c=$4).

Row 2 to Last Row Columns: A through Z

Col A: ***The Strategy Input/Filter Names***
Row 3: **4|0.25|2.75|0|1555|2.3|pf<2|r2<50 :** The inputs **4|0.25|2.75|0|1555|2.3|** for all in-sample files that have **pf<2 and r2≤50**.
Col B: ***toGP*** Total out-of-sample(oos) gross profit for these 342 oos periods (for this run periods = weeks).
Col C: ***toNP*** Total out-of-sample(oos) Net profit (toGP-(# of Trade days)*cost) for the 342 oos periods.
Col D: ***aoGP*** Average oos gross profit for the # oos periods
Col E: ***aoTr*** Average oos profit per trade
Col F: ***ao#T*** Average number of oos trades per week
Col G: ***#*** The number of oos periods this filter produced any profit or loss. Note for some oos periods there are no trades.

Col H: ***std*** the standard deviation of the # oos period profits and losses
Col I: ***skew*** The Skew statistic of the # oos period profits and losses.
Col J: ***kur*** the kurtosis statistic of the # oos period profits and losses
Col K: ***t*** the student t statistic for the # oos periods. The higher the t statistic the higher the probability that this result was not due to pure chance.
Col L: ***oW|oL*** Ratio of average oos winning trades divided by average oos losing trades.
Col M: ***%Wtr*** The percentage if oos winning trades.
Col N: ***%P*** percent of all oos periods that were profitable.
Col O ***LLtr*** the largest losing oos trade in all oos periods
Col P: ***LLp*** the largest losing oos period
Col Q: ***eqDD*** the oos equity drawdown
Col R: ***wpr*** the largest number of winning oos periods (weeks) in a row.
Col S: ***lpr*** the largest number of losing oos periods in a row.
There can be no strategy inputs that satisfies the given filter criteria, and no trades will be made during that period.
Col T: ***v20*** the straight-line trend of the oos equity curve for the last 20 bars.
Col U: ***KTau*** The Kendall rank coefficient is often used as a test statistic in a statistical hypothesis test to establish whether two variables may be regarded as statistically dependent. This test is non-parametric, as it does not rely on any assumptions on the distributions of X or Y or the distribution of (X,Y)
Col V: ***eqR2*** the correlation coefficient(r^2) of a straight line fit to the equity curve.
Col W: ***Blw*** The maximum number of oos periods the oos equity curve failed to make a new high.
Col X: ***tkr|bl*** =100*t*Ktau*eqR2/BE. This is a measure of the best equity curve.
Col Y: ***Prob*** The probability that the filters oos toNP was due to pure chance.

The Following columns are the results from 6/11/25-9/5/25 that were not included in the filter scan from 1/31/24 to 6/10/25.

Col z: ***toGPx*** Total gross profit for the 60 future excluded periods (for this run periods = days).
Col AA: ***toNPx*** Total Net profit for the 60 future excluded periods.
Col AB: ***aoTrx*** Average profit per trade for the 60 future excluded periods
Col AC: ***aoNTx*** Average number of trades per week for the 60 future excluded periods
Col AD: ***#x*** the number of the 120 future excluded periods this strategy/filter traded. Note for some periods there can be no strategy inputs/filter that satisfy the Strategy Inputs/Filter criteria, and no trades will be made during that period.
Col AE: ***tOnpNet -*** toNP+toNPx = Total Net Profits of oos+future periods

Table 1 Walk Forward Out-Of-Sample Performance Summary for the DIA 5-min RMedV Strategy

DIA-5 min bars 1/31/2024 - 9/5/2025.

Filter: **4|0.25|2.75|0|1555|2.3|pf<2|r2<50**: The strategy inputs **4|0.25|2.75|0|1555|2.3|** for all in-sample files that have **PF≤2 and R2 ≤50**.
are used to trade in the following out-of-sample sections.
IS-pf = In-sample pf
IS-r2 = in-sample equity r2
osnp = Daily out-of-sample gross profit in $
NOnp$4 = Daily out-of-sample net profit in $ = **osnp-ont*4**.
ont = The number of trades in the out-of-sample day
EQ=Equity = Running Sum of daily out-of-sample gross profits $
NetEq=Net Equity = running sum of the daily out-of-sample net profits in $
Note1: 0 rows indicate that no out-of-sample trades were made that day
Note2: if in-sample number of trades<2 then no trades were made in out-of-sample section

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
1/31/2024	4| .25| 2.75	pf<2|r2<50	3.06	88	0	0	0	0	0
2/1/2024	4| .25| 2.75	pf<2|r2<50	2.4	82	0	0	0	0	0
2/2/2024	4| .25| 2.75	pf<2|r2<50	2.84	81	0	0	0	0	0
2/5/2024	4| .25| 2.75	pf<2|r2<50	3.23	82	0	0	0	0	0
2/6/2024	4| .25| 2.75	pf<2|r2<50	3.14	81	0	0	0	0	0
2/7/2024	4| .25| 2.75	pf<2|r2<50	3.02	79	0	0	0	0	0
2/8/2024	4| .25| 2.75	pf<2|r2<50	2.91	80	0	0	0	0	0
2/9/2024	4| .25| 2.75	pf<2|r2<50	2.74	78	0	0	0	0	0
2/12/2024	4| .25| 2.75	pf<2|r2<50	2.45	79	0	0	0	0	0
2/13/2024	4| .25| 2.75	pf<2|r2<50	2.58	81	0	0	0	0	0
2/14/2024	4| .25| 2.75	pf<2|r2<50	2.41	79	0	0	0	0	0
2/15/2024	4| .25| 2.75	pf<2|r2<50	2.44	76	0	0	0	0	0
2/16/2024	4| .25| 2.75	pf<2|r2<50	2.27	76	0	0	0	0	0
2/20/2024	4| .25| 2.75	pf<2|r2<50	1.82	80	0	0	0	0	0
2/21/2024	4| .25| 2.75	pf<2|r2<50	1.71	77	0	0	0	0	0
2/22/2024	4| .25| 2.75	pf<2|r2<50	2.44	73	0	0	0	0	0
2/23/2024	4| .25| 2.75	pf<2|r2<50	2.53	70	0	0	0	0	0
2/26/2024	4| .25| 2.75	pf<2|r2<50	2.58	67	0	0	0	0	0
2/27/2024	4| .25| 2.75	pf<2|r2<50	2.06	61	0	0	0	0	0
2/29/2024	4| .25| 2.75	pf<2|r2<50	1.92	55	0	0	0	0	0
2/29/2024	4| .25| 2.75	pf<2|r2<50	2.77	47	0	0	0	0	0
3/1/2024	4| .25| 2.75	pf<2|r2<50	2.58	56	0	0	0	0	0
3/4/2024	4| .25| 2.75	pf<2|r2<50	2.34	55	0	0	0	0	0
3/5/2024	4| .25| 2.75	pf<2|r2<50	1.71	56	0	0	0	0	0
3/6/2024	4| .25| 2.75	pf<2|r2<50	1.06	50	-52	-56	1	-52	-56
3/7/2024	4| .25| 2.75	pf<2|r2<50	1	37	-42	-46	1	-94	-102
3/8/2024	4| .25| 2.75	pf<2|r2<50	0.98	22	-105	-109	1	-199	-211
3/11/2024	4| .25| 2.75	pf<2|r2<50	0.95	6	205	201	1	6	-10
3/12/2024	4| .25| 2.75	pf<2|r2<50	1.04	3	185	181	1	191	171
3/13/2024	4| .25| 2.75	pf<2|r2<50	1.32	3	-26	-30	1	165	141
3/14/2024	4| .25| 2.75	pf<2|r2<50	1.24	2	-229	-233	1	-64	-92
3/15/2024	4| .25| 2.75	pf<2|r2<50	0.88	1	-86	-90	1	-150	-182
3/18/2024	4| .25| 2.75	pf<2|r2<50	0.91	-1	-24	-28	1	-174	-210
3/19/2024	4| .25| 2.75	pf<2|r2<50	0.89	-4	260	256	1	86	46
3/20/2024	4| .25| 2.75	pf<2|r2<50	1.2	-9	392	388	1	478	434
3/21/2024	4| .25| 2.75	pf<2|r2<50	1.44	-2	29	25	1	507	459
3/22/2024	4| .25| 2.75	pf<2|r2<50	1.35	0	-56	-60	1	451	399
3/25/2024	4| .25| 2.75	pf<2|r2<50	1.28	4	-55	-63	2	396	336

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
3/26/2024	4| .25| 2.75	pf<2|r2<50	1.34	10	-23	-27	1	373	309
3/27/2024	4| .25| 2.75	pf<2|r2<50	1.29	12	186	182	1	559	491
3/28/2024	4| .25| 2.75	pf<2|r2<50	1.4	16	47	43	1	606	534
4/1/2024	4| .25| 2.75	pf<2|r2<50	1.19	37	-95	-99	1	511	435
4/2/2024	4| .25| 2.75	pf<2|r2<50	1.13	54	0	0	0	511	435
4/3/2024	4| .25| 2.75	pf<2|r2<50	1.68	71	0	0	0	511	435
4/4/2024	4| .25| 2.75	pf<2|r2<50	1.68	70	0	0	0	511	435
4/5/2024	4| .25| 2.75	pf<2|r2<50	1.14	28	270	266	1	781	701
4/8/2024	4| .25| 2.75	pf<2|r2<50	1.46	20	-81	-85	1	700	616
4/9/2024	4| .25| 2.75	pf<2|r2<50	1.21	14	-85	-97	3	615	519
4/10/2024	4| .25| 2.75	pf<2|r2<50	1.01	1	-172	-188	4	443	331
4/11/2024	4| .25| 2.75	pf<2|r2<50	0.93	-3	238	234	1	681	565
4/12/2024	4| .25| 2.75	pf<2|r2<50	1.2	-7	-316	-324	2	365	241
4/15/2024	4| .25| 2.75	pf<2|r2<50	1.05	-19	-353	-361	2	12	-120
4/16/2024	4| .25| 2.75	pf<2|r2<50	0.9	-48	-38	-50	3	-26	-170
4/17/2024	4| .25| 2.75	pf<2|r2<50	0.77	-70	-164	-168	1	-190	-338
4/18/2024	4| .25| 2.75	pf<2|r2<50	0.56	-73	-95	-99	1	-285	-437
4/19/2024	4| .25| 2.75	pf<2|r2<50	0.53	-75	75	71	1	-210	-366
4/22/2024	4| .25| 2.75	pf<2|r2<50	0.57	-78	140	136	1	-70	-230
4/23/2024	4| .25| 2.75	pf<2|r2<50	0.64	-80	191	187	1	121	-43
4/24/2024	4| .25| 2.75	pf<2|r2<50	0.72	-79	18	14	1	139	-29
4/25/2024	4| .25| 2.75	pf<2|r2<50	0.65	-75	380	372	2	519	343
4/26/2024	4| .25| 2.75	pf<2|r2<50	0.79	-58	44	40	1	563	383
4/29/2024	4| .25| 2.75	pf<2|r2<50	0.81	-49	21	17	1	584	400
4/30/2024	4| .25| 2.75	pf<2|r2<50	0.85	-36	-288	-296	2	296	104
5/1/2024	4| .25| 2.75	pf<2|r2<50	0.74	-18	281	273	2	577	377
5/2/2024	4| .25| 2.75	pf<2|r2<50	0.87	-6	138	134	1	715	511
5/3/2024	4| .25| 2.75	pf<2|r2<50	1.1	-2	110	106	1	825	617
5/6/2024	4| .25| 2.75	pf<2|r2<50	1.02	0	-26	-30	1	799	587
5/7/2024	4| .25| 2.75	pf<2|r2<50	1.05	2	-33	-37	1	766	550
5/8/2024	4| .25| 2.75	pf<2|r2<50	1.09	10	185	181	1	951	731
5/9/2024	4| .25| 2.75	pf<2|r2<50	1.36	31	307	303	1	1258	1034
5/10/2024	4| .25| 2.75	pf<2|r2<50	1.41	50	14	10	1	1272	1044
5/13/2024	4| .25| 2.75	pf<2|r2<50	1.84	77	0	0	0	1272	1044
5/14/2024	4| .25| 2.75	pf<2|r2<50	2.27	89	0	0	0	1272	1044
5/15/2024	4| .25| 2.75	pf<2|r2<50	2.58	92	0	0	0	1272	1044
5/16/2024	4| .25| 2.75	pf<2|r2<50	3.49	92	0	0	0	1272	1044
5/17/2024	4| .25| 2.75	pf<2|r2<50	4.25	92	0	0	0	1272	1044
5/20/2024	4| .25| 2.75	pf<2|r2<50	4.22	92	0	0	0	1272	1044
5/21/2024	4| .25| 2.75	pf<2|r2<50	2.96	91	0	0	0	1272	1044
5/22/2024	4| .25| 2.75	pf<2|r2<50	2.75	89	0	0	0	1272	1044
5/23/2024	4| .25| 2.75	pf<2|r2<50	2.01	83	0	0	0	1272	1044
5/24/2024	4| .25| 2.75	pf<2|r2<50	1.15	60	0	0	0	1272	1044
5/28/2024	4| .25| 2.75	pf<2|r2<50	1.06	36	-177	-181	1	1095	863
5/29/2024	4| .25| 2.75	pf<2|r2<50	1.15	8	-109	-117	2	986	746
5/30/2024	4| .25| 2.75	pf<2|r2<50	0.85	-7	-2	-10	2	984	736
5/31/2024	4| .25| 2.75	pf<2|r2<50	0.75	-28	439	435	1	1423	1171
6/3/2024	4| .25| 2.75	pf<2|r2<50	0.99	-33	-131	-135	1	1292	1036
6/4/2024	4| .25| 2.75	pf<2|r2<50	0.92	-43	142	138	1	1434	1174
6/5/2024	4| .25| 2.75	pf<2|r2<50	1.04	-51	62	58	1	1496	1232
6/6/2024	4| .25| 2.75	pf<2|r2<50	0.95	-52	-12	-16	1	1484	1216
6/7/2024	4| .25| 2.75	pf<2|r2<50	0.73	-44	0	-4	1	1484	1212
6/10/2024	4| .25| 2.75	pf<2|r2<50	0.72	-36	73	69	1	1557	1281
6/11/2024	4| .25| 2.75	pf<2|r2<50	0.87	-29	267	259	2	1824	1540
6/12/2024	4| .25| 2.75	pf<2|r2<50	1.01	-10	-345	-357	3	1479	1183
6/13/2024	4| .25| 2.75	pf<2|r2<50	0.72	-4	274	266	2	1753	1449
6/14/2024	4| .25| 2.75	pf<2|r2<50	0.85	0	322	314	2	2075	1763
6/17/2024	4| .25| 2.75	pf<2|r2<50	1	14	293	289	1	2368	2052
6/18/2024	4| .25| 2.75	pf<2|r2<50	1.32	34	-47	-51	1	2321	2001

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
6/20/2024	4| .25| 2.75	pf<2|r2<50	1.49	73	0	0	0	2321	2001
6/21/2024	4| .25| 2.75	pf<2|r2<50	2.31	79	0	0	0	2321	2001
6/24/2024	4| .25| 2.75	pf<2|r2<50	2.47	83	0	0	0	2321	2001
6/25/2024	4| .25| 2.75	pf<2|r2<50	2.76	84	0	0	0	2321	2001
6/26/2024	4| .25| 2.75	pf<2|r2<50	2.69	86	0	0	0	2321	2001
6/27/2024	4| .25| 2.75	pf<2|r2<50	3.29	86	0	0	0	2321	2001
6/28/2024	4| .25| 2.75	pf<2|r2<50	3.35	84	0	0	0	2321	2001
7/1/2024	4| .25| 2.75	pf<2|r2<50	2.03	85	0	0	0	2321	2001
7/2/2024	4| .25| 2.75	pf<2|r2<50	2.4	84	0	0	0	2321	2001
7/3/2024	4| .25| 2.75	pf<2|r2<50	2.41	84	0	0	0	2321	2001
7/5/2024	4| .25| 2.75	pf<2|r2<50	2.22	83	0	0	0	2321	2001
7/8/2024	4| .25| 2.75	pf<2|r2<50	2.4	83	0	0	0	2321	2001
7/9/2024	4| .25| 2.75	pf<2|r2<50	1.78	78	0	0	0	2321	2001
7/10/2024	4| .25| 2.75	pf<2|r2<50	1.66	75	0	0	0	2321	2001
7/11/2024	4| .25| 2.75	pf<2|r2<50	2.83	66	0	0	0	2321	2001
7/12/2024	4| .25| 2.75	pf<2|r2<50	2.54	62	0	0	0	2321	2001
7/15/2024	4| .25| 2.75	pf<2|r2<50	2.34	56	0	0	0	2321	2001
7/16/2024	4| .25| 2.75	pf<2|r2<50	1.83	57	0	0	0	2321	2001
7/17/2024	4| .25| 2.75	pf<2|r2<50	2.18	58	0	0	0	2321	2001
7/18/2024	4| .25| 2.75	pf<2|r2<50	2.27	64	0	0	0	2321	2001
7/19/2024	4| .25| 2.75	pf<2|r2<50	1.17	51	0	0	0	2321	2001
7/22/2024	4| .25| 2.75	pf<2|r2<50	0.98	19	96	92	1	2417	2093
7/23/2024	4| .25| 2.75	pf<2|r2<50	0.9	12	-57	-61	1	2360	2032
7/24/2024	4| .25| 2.75	pf<2|r2<50	0.98	3	59	51	2	2419	2083
7/25/2024	4| .25| 2.75	pf<2|r2<50	0.92	1	505	493	3	2924	2576
7/26/2024	4| .25| 2.75	pf<2|r2<50	1.17	5	145	141	1	3069	2717
7/29/2024	4| .25| 2.75	pf<2|r2<50	1.45	5	70	66	1	3139	2783
7/30/2024	4| .25| 2.75	pf<2|r2<50	1.45	6	124	120	1	3263	2903
7/31/2024	4| .25| 2.75	pf<2|r2<50	1.43	9	68	56	3	3331	2959
8/1/2024	4| .25| 2.75	pf<2|r2<50	1.55	23	213	201	3	3544	3160
8/2/2024	4| .25| 2.75	pf<2|r2<50	1.55	37	278	262	4	3822	3422
8/5/2024	4| .25| 2.75	pf<2|r2<50	1.54	50	-387	-403	4	3435	3019
8/6/2024	4| .25| 2.75	pf<2|r2<50	1.47	55	0	0	0	3435	3019
8/7/2024	4| .25| 2.75	pf<2|r2<50	1.25	39	-473	-477	1	2962	2542
8/8/2024	4| .25| 2.75	pf<2|r2<50	0.94	30	353	349	1	3315	2891
8/9/2024	4| .25| 2.75	pf<2|r2<50	1.04	26	133	129	1	3448	3020
8/12/2024	4| .25| 2.75	pf<2|r2<50	1.04	26	4	0	1	3452	3020
8/13/2024	4| .25| 2.75	pf<2|r2<50	1.07	25	269	265	1	3721	3285
8/14/2024	4| .25| 2.75	pf<2|r2<50	1.08	29	253	249	1	3974	3534
8/15/2024	4| .25| 2.75	pf<2|r2<50	1.13	36	-18	-22	1	3956	3512
8/16/2024	4| .25| 2.75	pf<2|r2<50	1.42	36	129	125	1	4085	3637
8/19/2024	4| .25| 2.75	pf<2|r2<50	1.66	31	73	69	1	4158	3706
8/20/2024	4| .25| 2.75	pf<2|r2<50	1.65	30	-44	-48	1	4114	3658
8/21/2024	4| .25| 2.75	pf<2|r2<50	1.66	28	-101	-113	3	4013	3545
8/22/2024	4| .25| 2.75	pf<2|r2<50	1.58	24	-151	-155	1	3862	3390
8/23/2024	4| .25| 2.75	pf<2|r2<50	1.29	13	280	276	1	4142	3666
8/26/2024	4| .25| 2.75	pf<2|r2<50	1.34	14	-157	-161	1	3985	3505
8/27/2024	4| .25| 2.75	pf<2|r2<50	1.23	13	31	27	1	4016	3532
8/28/2024	4| .25| 2.75	pf<2|r2<50	1.19	13	-161	-165	1	3855	3367
8/29/2024	4| .25| 2.75	pf<2|r2<50	1.1	12	106	94	3	3961	3461
8/30/2024	4| .25| 2.75	pf<2|r2<50	1.06	17	139	135	1	4100	3596
9/3/2024	4| .25| 2.75	pf<2|r2<50	1.23	53	0	0	0	4100	3596
9/4/2024	4| .25| 2.75	pf<2|r2<50	1.45	48	-88	-92	1	4012	3504
9/5/2024	4| .25| 2.75	pf<2|r2<50	1.96	40	-175	-179	1	3837	3325
9/6/2024	4| .25| 2.75	pf<2|r2<50	1.41	23	-244	-256	3	3593	3069
9/9/2024	4| .25| 2.75	pf<2|r2<50	1.09	0	202	198	1	3795	3267
9/10/2024	4| .25| 2.75	pf<2|r2<50	1.23	-11	-82	-86	1	3713	3181
9/11/2024	4| .25| 2.75	pf<2|r2<50	0.99	-27	960	952	2	4673	4133
9/12/2024	4| .25| 2.75	pf<2|r2<50	1.44	-3	153	141	3	4826	4274

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
9/13/2024	4| .25| 2.75	pf<2|r2<50	1.51	7	77	73	1	4903	4347
9/16/2024	4| .25| 2.75	pf<2|r2<50	1.48	15	-15	-19	1	4888	4328
9/17/2024	4| .25| 2.75	pf<2|r2<50	1.42	24	-170	-174	1	4718	4154
9/18/2024	4| .25| 2.75	pf<2|r2<50	1.33	32	-351	-363	3	4367	3791
9/19/2024	4| .25| 2.75	pf<2|r2<50	1.17	41	-151	-171	5	4216	3620
9/20/2024	4| .25| 2.75	pf<2|r2<50	1.16	22	127	119	2	4343	3739
9/23/2024	4| .25| 2.75	pf<2|r2<50	1.09	21	45	41	1	4388	3780
9/24/2024	4| .25| 2.75	pf<2|r2<50	1.2	21	28	24	1	4416	3804
9/25/2024	4| .25| 2.75	pf<2|r2<50	1.2	21	-153	-157	1	4263	3647
9/26/2024	4| .25| 2.75	pf<2|r2<50	1.2	17	42	38	1	4305	3685
9/27/2024	4| .25| 2.75	pf<2|r2<50	1.17	12	-24	-28	1	4281	3657
9/30/2024	4| .25| 2.75	pf<2|r2<50	1.09	11	165	157	2	4446	3814
10/1/2024	4| .25| 2.75	pf<2|r2<50	1.17	11	86	78	2	4532	3892
10/2/2024	4| .25| 2.75	pf<2|r2<50	1.25	14	157	153	1	4689	4045
10/3/2024	4| .25| 2.75	pf<2|r2<50	1.41	14	90	74	4	4779	4119
10/4/2024	4| .25| 2.75	pf<2|r2<50	1.63	21	160	156	1	4939	4275
10/7/2024	4| .25| 2.75	pf<2|r2<50	2.07	9	0	0	0	4939	4275
10/8/2024	4| .25| 2.75	pf<2|r2<50	1.61	6	165	161	1	5104	4436
10/9/2024	4| .25| 2.75	pf<2|r2<50	1.82	4	356	352	1	5460	4788
10/10/2024	4| .25| 2.75	pf<2|r2<50	1.39	6	-10	-14	1	5450	4774
10/11/2024	4| .25| 2.75	pf<2|r2<50	1.3	20	228	224	1	5678	4998
10/14/2024	4| .25| 2.75	pf<2|r2<50	1.42	36	240	236	1	5918	5234
10/15/2024	4| .25| 2.75	pf<2|r2<50	1.62	52	0	0	0	5918	5234
10/16/2024	4| .25| 2.75	pf<2|r2<50	1.73	67	0	0	0	5918	5234
10/17/2024	4| .25| 2.75	pf<2|r2<50	2.86	86	0	0	0	5918	5234
10/18/2024	4| .25| 2.75	pf<2|r2<50	4.21	88	0	0	0	5918	5234
10/21/2024	4| .25| 2.75	pf<2|r2<50	3.88	91	0	0	0	5918	5234
10/22/2024	4| .25| 2.75	pf<2|r2<50	2.53	92	0	0	0	5918	5234
10/23/2024	4| .25| 2.75	pf<2|r2<50	2.71	94	0	0	0	5918	5234
10/24/2024	4| .25| 2.75	pf<2|r2<50	2.67	93	0	0	0	5918	5234
10/25/2024	4| .25| 2.75	pf<2|r2<50	2.53	91	0	0	0	5918	5234
10/28/2024	4| .25| 2.75	pf<2|r2<50	1.82	82	0	0	0	5918	5234
10/29/2024	4| .25| 2.75	pf<2|r2<50	1.7	71	0	0	0	5918	5234
10/30/2024	4| .25| 2.75	pf<2|r2<50	1.55	47	-63	-67	1	5855	5167
10/31/2024	4| .25| 2.75	pf<2|r2<50	1.37	35	-143	-151	2	5712	5016
11/1/2024	4| .25| 2.75	pf<2|r2<50	1.2	3	-53	-57	1	5659	4959
11/4/2024	4| .25| 2.75	pf<2|r2<50	1.06	0	-145	-149	1	5514	4810
11/5/2024	4| .25| 2.75	pf<2|r2<50	1.12	-9	311	307	1	5825	5117
11/6/2024	4| .25| 2.75	pf<2|r2<50	1.22	-26	242	238	1	6067	5355
11/7/2024	4| .25| 2.75	pf<2|r2<50	1.14	-36	-16	-20	1	6051	5335
11/8/2024	4| .25| 2.75	pf<2|r2<50	1.14	-48	200	196	1	6251	5531
11/11/2024	4| .25| 2.75	pf<2|r2<50	1.12	-48	-92	-96	1	6159	5435
11/12/2024	4| .25| 2.75	pf<2|r2<50	0.91	-44	-257	-261	1	5902	5174
11/13/2024	4| .25| 2.75	pf<2|r2<50	0.82	-50	-54	-58	1	5848	5116
11/14/2024	4| .25| 2.75	pf<2|r2<50	0.63	-48	-235	-239	1	5613	4877
11/15/2024	4| .25| 2.75	pf<2|r2<50	0.52	-47	-155	-163	2	5458	4714
11/18/2024	4| .25| 2.75	pf<2|r2<50	0.44	-46	-31	-35	1	5427	4679
11/19/2024	4| .25| 2.75	pf<2|r2<50	0.5	-47	256	248	2	5683	4927
11/20/2024	4| .25| 2.75	pf<2|r2<50	0.53	-45	114	110	1	5797	5037
11/21/2024	4| .25| 2.75	pf<2|r2<50	0.65	-28	391	387	1	6188	5424
11/22/2024	4| .25| 2.75	pf<2|r2<50	0.89	-8	269	265	1	6457	5689
11/25/2024	4| .25| 2.75	pf<2|r2<50	1.36	0	1	-3	1	6458	5686
11/26/2024	4| .25| 2.75	pf<2|r2<50	1.36	2	303	295	2	6761	5981
11/27/2024	4| .25| 2.75	pf<2|r2<50	1.67	18	-204	-208	1	6557	5773
11/29/2024	4| .25| 2.75	pf<2|r2<50	1.67	26	112	108	1	6669	5881
12/2/2024	4| .25| 2.75	pf<2|r2<50	1.84	31	32	28	1	6701	5909
12/3/2024	4| .25| 2.75	pf<2|r2<50	2.12	32	0	0	0	6701	5909
12/4/2024	4| .25| 2.75	pf<2|r2<50	1.8	42	172	168	1	6873	6077
12/5/2024	4| .25| 2.75	pf<2|r2<50	1.73	51	0	0	0	6873	6077

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
12/6/2024	4| .25| 2.75	pf<2|r2<50	1.45	57	0	0	0	6873	6077
12/9/2024	4| .25| 2.75	pf<2|r2<50	1.09	63	0	0	0	6873	6077
12/10/2024	4| .25| 2.75	pf<2|r2<50	0.97	60	0	0	0	6873	6077
12/11/2024	4| .25| 2.75	pf<2|r2<50	1.08	41	-151	-155	1	6722	5922
12/12/2024	4| .25| 2.75	pf<2|r2<50	1.02	29	-275	-279	1	6447	5643
12/13/2024	4| .25| 2.75	pf<2|r2<50	1	13	-209	-213	1	6238	5430
12/16/2024	4| .25| 2.75	pf<2|r2<50	0.97	0	-141	-145	1	6097	5285
12/17/2024	4| .25| 2.75	pf<2|r2<50	0.91	-5	-40	-48	2	6057	5237
12/18/2024	4| .25| 2.75	pf<2|r2<50	0.76	-45	537	529	2	6594	5766
12/19/2024	4| .25| 2.75	pf<2|r2<50	0.98	-65	-130	-138	2	6464	5628
12/20/2024	4| .25| 2.75	pf<2|r2<50	0.76	-69	543	539	1	7007	6167
12/23/2024	4| .25| 2.75	pf<2|r2<50	0.88	-61	399	391	2	7406	6558
12/24/2024	4| .25| 2.75	pf<2|r2<50	1.05	-37	349	345	1	7755	6903
12/26/2024	4| .25| 2.75	pf<2|r2<50	1.17	-15	158	154	1	7913	7057
12/27/2024	4| .25| 2.75	pf<2|r2<50	1.24	-5	-215	-231	4	7698	6826
12/30/2024	4| .25| 2.75	pf<2|r2<50	1.08	2	441	433	2	8139	7259
12/31/2024	4| .25| 2.75	pf<2|r2<50	1.25	11	-154	-158	1	7985	7101
1/2/2025	4| .25| 2.75	pf<2|r2<50	1.11	38	-215	-239	6	7770	6862
1/3/2025	4| .25| 2.75	pf<2|r2<50	1.11	57	0	0	0	7770	6862
1/6/2025	4| .25| 2.75	pf<2|r2<50	1.26	63	0	0	0	7770	6862
1/7/2025	4| .25| 2.75	pf<2|r2<50	1.31	65	0	0	0	7770	6862
1/8/2025	4| .25| 2.75	pf<2|r2<50	1.1	54	0	0	0	7770	6862
1/9/2025	4| .25| 2.75	pf<2|r2<50	1.22	50	0	0	0	7770	6862
1/10/2025	4| .25| 2.75	pf<2|r2<50	1.37	47	1	-15	4	7771	6847
1/13/2025	4| .25| 2.75	pf<2|r2<50	1.46	32	313	309	1	8084	7156
1/14/2025	4| .25| 2.75	pf<2|r2<50	1.7	27	-57	-69	3	8027	7087
1/15/2025	4| .25| 2.75	pf<2|r2<50	1.64	12	11	7	1	8038	7094
1/16/2025	4| .25| 2.75	pf<2|r2<50	1.47	2	-38	-42	1	8000	7052
1/17/2025	4| .25| 2.75	pf<2|r2<50	1.54	-5	79	75	1	8079	7127
1/21/2025	4| .25| 2.75	pf<2|r2<50	1.1	-40	348	344	1	8427	7471
1/22/2025	4| .25| 2.75	pf<2|r2<50	0.93	-26	29	25	1	8456	7496
1/23/2025	4| .25| 2.75	pf<2|r2<50	1.12	-16	278	274	1	8734	7770
1/24/2025	4| .25| 2.75	pf<2|r2<50	1.18	-4	-62	-66	1	8672	7704
1/27/2025	4| .25| 2.75	pf<2|r2<50	1.29	0	285	281	1	8957	7985
1/28/2025	4| .25| 2.75	pf<2|r2<50	1.2	4	62	50	3	9019	8035
1/29/2025	4| .25| 2.75	pf<2|r2<50	1.35	26	-158	-162	1	8861	7873
1/30/2025	4| .25| 2.75	pf<2|r2<50	1.23	31	-365	-373	2	8496	7500
1/31/2025	4| .25| 2.75	pf<2|r2<50	1.15	64	0	0	0	8496	7500
2/3/2025	4| .25| 2.75	pf<2|r2<50	0.84	41	617	609	2	9113	8109
2/4/2025	4| .25| 2.75	pf<2|r2<50	1.21	37	131	127	1	9244	8236
2/5/2025	4| .25| 2.75	pf<2|r2<50	1.67	30	19	7	3	9263	8243
2/6/2025	4| .25| 2.75	pf<2|r2<50	1.48	25	-30	-34	1	9233	8209
2/7/2025	4| .25| 2.75	pf<2|r2<50	1.46	27	-508	-520	3	8725	7689
2/10/2025	4| .25| 2.75	pf<2|r2<50	1.18	8	33	29	1	8758	7718
2/11/2025	4| .25| 2.75	pf<2|r2<50	1.05	4	201	197	1	8959	7915
2/12/2025	4| .25| 2.75	pf<2|r2<50	1.18	0	-22	-30	2	8937	7885
2/13/2025	4| .25| 2.75	pf<2|r2<50	1.16	-3	286	282	1	9223	8167
2/14/2025	4| .25| 2.75	pf<2|r2<50	1.31	-6	-173	-177	1	9050	7990
2/18/2025	4| .25| 2.75	pf<2|r2<50	1.18	-12	69	65	1	9119	8055
2/19/2025	4| .25| 2.75	pf<2|r2<50	1.06	-13	183	179	1	9302	8234
2/20/2025	4| .25| 2.75	pf<2|r2<50	1.13	-10	362	354	2	9664	8588
2/21/2025	4| .25| 2.75	pf<2|r2<50	1.16	0	-244	-252	2	9420	8336
2/24/2025	4| .25| 2.75	pf<2|r2<50	1.08	1	-133	-137	1	9287	8199
2/25/2025	4| .25| 2.75	pf<2|r2<50	0.92	4	-81	-85	1	9206	8114
2/26/2025	4| .25| 2.75	pf<2|r2<50	0.87	24	-171	-175	1	9035	7939
2/27/2025	4| .25| 2.75	pf<2|r2<50	0.87	31	-113	-121	2	8922	7818
2/28/2025	4| .25| 2.75	pf<2|r2<50	0.95	25	309	297	3	9231	8115
3/3/2025	4| .25| 2.75	pf<2|r2<50	1.31	2	-151	-163	3	9080	7952
3/4/2025	4| .25| 2.75	pf<2|r2<50	0.99	0	771	759	3	9851	8711

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
3/5/2025	4| .25| 2.75	pf<2|r2<50	1.21	5	380	376	1	10231	9087
3/6/2025	4| .25| 2.75	pf<2|r2<50	1.39	11	233	217	4	10464	9304
3/7/2025	4| .25| 2.75	pf<2|r2<50	1.5	38	-470	-498	7	9994	8806
3/10/2025	4| .25| 2.75	pf<2|r2<50	1.43	40	-667	-679	3	9327	8127
3/11/2025	4| .25| 2.75	pf<2|r2<50	1.16	31	17	-7	6	9344	8120
3/12/2025	4| .25| 2.75	pf<2|r2<50	1.1	10	254	234	5	9598	8354
3/13/2025	4| .25| 2.75	pf<2|r2<50	1.16	5	-585	-597	3	9013	7757
3/14/2025	4| .25| 2.75	pf<2|r2<50	0.95	1	542	538	1	9555	8295
3/17/2025	4| .25| 2.75	pf<2|r2<50	1.11	1	244	240	1	9799	8535
3/18/2025	4| .25| 2.75	pf<2|r2<50	1.17	1	16	8	2	9815	8543
3/19/2025	4| .25| 2.75	pf<2|r2<50	1.15	2	-63	-75	3	9752	8468
3/20/2025	4| .25| 2.75	pf<2|r2<50	1.1	3	-52	-68	4	9700	8400
3/21/2025	4| .25| 2.75	pf<2|r2<50	1.01	5	400	392	2	10100	8792
3/24/2025	4| .25| 2.75	pf<2|r2<50	1.15	8	133	129	1	10233	8921
3/25/2025	4| .25| 2.75	pf<2|r2<50	1.22	10	-11	-15	1	10222	8906
3/26/2025	4| .25| 2.75	pf<2|r2<50	1.24	11	-328	-332	1	9894	8574
3/27/2025	4| .25| 2.75	pf<2|r2<50	1.19	10	-102	-110	2	9792	8464
3/28/2025	4| .25| 2.75	pf<2|r2<50	1.2	6	-143	-147	1	9649	8317
3/31/2025	4| .25| 2.75	pf<2|r2<50	1.1	1	556	548	2	10205	8865
4/1/2025	4| .25| 2.75	pf<2|r2<50	1.29	0	221	205	4	10426	9070
4/2/2025	4| .25| 2.75	pf<2|r2<50	1.14	1	404	400	1	10830	9470
4/3/2025	4| .25| 2.75	pf<2|r2<50	1.15	4	274	266	2	11104	9736
4/4/2025	4| .25| 2.75	pf<2|r2<50	1.15	31	-25	-85	15	11079	9651
4/7/2025	4| .25| 2.75	pf<2|r2<50	1.26	76	0	0	0	11079	9651
4/8/2025	4| .25| 2.75	pf<2|r2<50	1.3	84	0	0	0	11079	9651
4/9/2025	4| .25| 2.75	pf<2|r2<50	0.99	37	1754	1714	10	12833	11365
4/10/2025	4| .25| 2.75	pf<2|r2<50	1.19	8	-1205	-1257	13	11628	10108
4/11/2025	4| .25| 2.75	pf<2|r2<50	1.09	4	477	457	5	12105	10565
4/14/2025	4| .25| 2.75	pf<2|r2<50	1.08	0	615	603	3	12720	11168
4/15/2025	4| .25| 2.75	pf<2|r2<50	1.12	0	-251	-255	1	12469	10913
4/16/2025	4| .25| 2.75	pf<2|r2<50	1.09	0	-107	-123	4	12362	10790
4/17/2025	4| .25| 2.75	pf<2|r2<50	1.08	0	-146	-154	2	12216	10636
4/21/2025	4| .25| 2.75	pf<2|r2<50	1.03	-3	67	59	2	12283	10695
4/22/2025	4| .25| 2.75	pf<2|r2<50	1.02	-3	593	581	3	12876	11276
4/23/2025	4| .25| 2.75	pf<2|r2<50	1.08	-3	-348	-368	5	12528	10908
4/24/2025	4| .25| 2.75	pf<2|r2<50	1.08	-2	523	515	2	13051	11423
4/25/2025	4| .25| 2.75	pf<2|r2<50	1.14	-3	135	123	3	13186	11546
4/28/2025	4| .25| 2.75	pf<2|r2<50	1.16	-3	-18	-26	2	13168	11520
4/29/2025	4| .25| 2.75	pf<2|r2<50	1.11	-3	230	226	1	13398	11746
4/30/2025	4| .25| 2.75	pf<2|r2<50	1.11	-5	1021	1013	2	14419	12759
5/1/2025	4| .25| 2.75	pf<2|r2<50	1.17	-2	-54	-58	1	14365	12701
5/2/2025	4| .25| 2.75	pf<2|r2<50	1.14	-1	113	109	1	14478	12810
5/5/2025	4| .25| 2.75	pf<2|r2<50	1.17	0	-59	-67	2	14419	12743
5/6/2025	4| .25| 2.75	pf<2|r2<50	1.23	36	65	57	2	14484	12800
5/7/2025	4| .25| 2.75	pf<2|r2<50	1.64	53	0	0	0	14484	12800
5/8/2025	4| .25| 2.75	pf<2|r2<50	1.22	58	0	0	0	14484	12800
5/9/2025	4| .25| 2.75	pf<2|r2<50	1.83	84	0	0	0	14484	12800
5/12/2025	4| .25| 2.75	pf<2|r2<50	1.64	78	0	0	0	14484	12800
5/13/2025	4| .25| 2.75	pf<2|r2<50	1.47	78	0	0	0	14484	12800
5/14/2025	4| .25| 2.75	pf<2|r2<50	1.56	77	0	0	0	14484	12800
5/15/2025	4| .25| 2.75	pf<2|r2<50	1.61	73	0	0	0	14484	12800
5/16/2025	4| .25| 2.75	pf<2|r2<50	1.78	65	0	0	0	14484	12800
5/19/2025	4| .25| 2.75	pf<2|r2<50	1.93	66	0	0	0	14484	12800
5/20/2025	4| .25| 2.75	pf<2|r2<50	2.11	64	0	0	0	14484	12800
5/21/2025	4| .25| 2.75	pf<2|r2<50	1.76	59	0	0	0	14484	12800
5/22/2025	4| .25| 2.75	pf<2|r2<50	1.49	33	117	113	1	14601	12913
5/23/2025	4| .25| 2.75	pf<2|r2<50	1.34	19	85	81	1	14686	12994
5/27/2025	4| .25| 2.75	pf<2|r2<50	1.36	-2	356	352	1	15042	13346
5/28/2025	4| .25| 2.75	pf<2|r2<50	1.42	-7	-333	-337	1	14709	13009

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
5/29/2025	4| .25| 2.75	pf<2|r2<50	0.8	-16	23	19	1	14732	13028
5/30/2025	4| .25| 2.75	pf<2|r2<50	0.83	-16	27	15	3	14759	13043
6/2/2025	4| .25| 2.75	pf<2|r2<50	0.81	-20	311	307	1	15070	13350
6/3/2025	4| .25| 2.75	pf<2|r2<50	0.95	-9	173	169	1	15243	13519
6/4/2025	4| .25| 2.75	pf<2|r2<50	1	0	-95	-99	1	15148	13420
6/5/2025	4| .25| 2.75	pf<2|r2<50	1.21	2	-94	-106	3	15054	13314
6/6/2025	4| .25| 2.75	pf<2|r2<50	1.12	7	-13	-17	1	15041	13297
6/9/2025	4| .25| 2.75	pf<2|r2<50	1.21	7	149	145	1	15190	13442
6/10/2025	4| .25| 2.75	pf<2|r2<50	1.21	9	62	58	1	15252	13500
6/11/2025	4| .25| 2.75	pf<2|r2<50	1.31	10	-39	-43	1	15213	13457
6/12/2025	4| .25| 2.75	pf<2|r2<50	1.36	9	218	210	2	15431	13667
6/13/2025	4| .25| 2.75	pf<2|r2<50	1.38	9	-51	-59	2	15380	13608
6/16/2025	4| .25| 2.75	pf<2|r2<50	1.14	22	-199	-203	1	15181	13405
6/17/2025	4| .25| 2.75	pf<2|r2<50	0.92	39	-203	-207	1	14978	13198
6/18/2025	4| .25| 2.75	pf<2|r2<50	0.87	47	-17	-29	3	14961	13169
6/20/2025	4| .25| 2.75	pf<2|r2<50	1.24	32	-103	-107	1	14858	13062
6/23/2025	4| .25| 2.75	pf<2|r2<50	1.11	19	318	314	1	15176	13376
6/24/2025	4| .25| 2.75	pf<2|r2<50	1.3	19	203	199	1	15379	13575
6/25/2025	4| .25| 2.75	pf<2|r2<50	1.21	25	-111	-115	1	15268	13460
6/26/2025	4| .25| 2.75	pf<2|r2<50	1.4	22	183	179	1	15451	13639
6/27/2025	4| .25| 2.75	pf<2|r2<50	1.52	22	50	46	1	15501	13685
6/30/2025	4| .25| 2.75	pf<2|r2<50	1.64	5	184	180	1	15685	13865
7/1/2025	4| .25| 2.75	pf<2|r2<50	1.53	10	424	420	1	16109	14285
7/2/2025	4| .25| 2.75	pf<2|r2<50	1.75	22	47	43	1	16156	14328
7/3/2025	4| .25| 2.75	pf<2|r2<50	1.95	31	174	170	1	16330	14498
7/7/2025	4| .25| 2.75	pf<2|r2<50	2.35	35	0	0	0	16330	14498
7/8/2025	4| .25| 2.75	pf<2|r2<50	1.55	40	-134	-138	1	16196	14360
7/9/2025	4| .25| 2.75	pf<2|r2<50	1.37	44	-29	-33	1	16167	14327
7/10/2025	4| .25| 2.75	pf<2|r2<50	1.38	46	175	171	1	16342	14498
7/11/2025	4| .25| 2.75	pf<2|r2<50	1.35	55	0	0	0	16342	14498
7/14/2025	4| .25| 2.75	pf<2|r2<50	1.45	73	0	0	0	16342	14498
7/15/2025	4| .25| 2.75	pf<2|r2<50	1.81	75	0	0	0	16342	14498
7/16/2025	4| .25| 2.75	pf<2|r2<50	1.71	66	0	0	0	16342	14498
7/17/2025	4| .25| 2.75	pf<2|r2<50	1.47	16	123	111	3	16465	14609
7/18/2025	4| .25| 2.75	pf<2|r2<50	1.53	9	11	7	1	16476	14616
7/21/2025	4| .25| 2.75	pf<2|r2<50	1.65	2	-84	-88	1	16392	14528
7/22/2025	4| .25| 2.75	pf<2|r2<50	1.34	0	107	103	1	16499	14631
7/23/2025	4| .25| 2.75	pf<2|r2<50	1.28	-1	244	240	1	16743	14871
7/24/2025	4| .25| 2.75	pf<2|r2<50	1.56	-3	-82	-90	2	16661	14781
7/25/2025	4| .25| 2.75	pf<2|r2<50	1.34	-3	132	128	1	16793	14909
7/28/2025	4| .25| 2.75	pf<2|r2<50	1.4	-4	-87	-91	1	16706	14818
7/29/2025	4| .25| 2.75	pf<2|r2<50	1.2	-4	-221	-225	1	16485	14593
7/30/2025	4| .25| 2.75	pf<2|r2<50	0.81	-2	-43	-55	3	16442	14538
7/31/2025	4| .25| 2.75	pf<2|r2<50	0.78	-2	-316	-320	1	16126	14218
8/1/2025	4| .25| 2.75	pf<2|r2<50	0.55	-1	75	71	1	16201	14289
8/4/2025	4| .25| 2.75	pf<2|r2<50	0.63	-4	252	248	1	16453	14537
8/5/2025	4| .25| 2.75	pf<2|r2<50	0.9	-2	127	123	1	16580	14660
8/6/2025	4| .25| 2.75	pf<2|r2<50	1.04	-1	78	74	1	16658	14734
8/7/2025	4| .25| 2.75	pf<2|r2<50	1.11	0	14	2	3	16672	14736
8/8/2025	4| .25| 2.75	pf<2|r2<50	1.01	2	62	58	1	16734	14794
8/11/2025	4| .25| 2.75	pf<2|r2<50	1.04	9	-262	-266	1	16472	14528
8/12/2025	4| .25| 2.75	pf<2|r2<50	0.88	16	210	206	1	16682	14734
8/13/2025	4| .25| 2.75	pf<2|r2<50	1.11	20	186	182	1	16868	14916
8/14/2025	4| .25| 2.75	pf<2|r2<50	1.34	11	147	139	2	17015	15055
8/15/2025	4| .25| 2.75	pf<2|r2<50	1.37	14	-142	-146	1	16873	14909
8/18/2025	4| .25| 2.75	pf<2|r2<50	1.24	17	-27	-31	1	16846	14878
8/19/2025	4| .25| 2.75	pf<2|r2<50	1.29	18	-163	-167	1	16683	14711
8/20/2025	4| .25| 2.75	pf<2|r2<50	1.11	17	-40	-44	1	16643	14667
8/21/2025	4| .25| 2.75	pf<2|r2<50	0.94	21	94	86	2	16737	14753

Date	Inputs	Filter	pf	r2	osnp	NOnp$4	ont	EQ	NetEq
8/22/2025	4| .25| 2.75	pf<2|r2<50	1.05	29	218	214	1	16955	14967
8/25/2025	4| .25| 2.75	pf<2|r2<50	1.1	46	-109	-113	1	16846	14854
8/26/2025	4| .25| 2.75	pf<2|r2<50	1.08	57	0	0	0	16846	14854
8/27/2025	4| .25| 2.75	pf<2|r2<50	1.3	60	0	0	0	16846	14854
8/28/2025	4| .25| 2.75	pf<2|r2<50	1.42	56	0	0	0	16846	14854
8/29/2025	4| .25| 2.75	pf<2|r2<50	2.02	57	0	0	0	16846	14854
9/2/2025	4| .25| 2.75	pf<2|r2<50	1.53	50	212	204	2	17058	15058
9/3/2025	4| .25| 2.75	pf<2|r2<50	1.59	56	0	0	0	17058	15058
9/4/2025	4| .25| 2.75	pf<2|r2<50	1.56	61	0	0	0	17058	15058
9/5/2025	4| .25| 2.75	pf<2|r2<50	2.09	58	0	0	0	17058	15058

Repeated Median Velocity Normalization Multiplier

One of the inputs to the calculation of RMedV is **N,** the number of lookback bars. When we plot the RMedV we notice that the amplitude, and the maximum and minimum values of the RMedV vary quite significantly with different **N** inputs.

Below is a table, generated by the #iRMedVtMULTSTD indicator of the standard deviation(SD) of the 108333 calculated RMedV values for different **N**. We used 5 min bars of the CL from 3/8/2014 to 2/12/2016 to generate this table.

@CL 5 min bars Date Range 1140803 to 1160212
Total Number of Bars=108333 Sqrt(n) Norm=0
Trading Times Constraint Start Time=800 EndTime=1430
RMedVx Multiplier to Scale RMedVx N Range to One Std

4 Std=0.0734077 1/std=13.6226
6 Std=0.056242 1/std=17.7803
8 Std=0.0470003 1/std=21.2765
10 Std=0.0414414 1/std=24.1304
12 Std=0.0375377 1/std=26.6342
14 Std=0.0346289 1/std=28.8776
16 Std=0.0322738 1/std=30.9849
18 Std=0.0302342 1/std=33.0689
20 Std=0.0285976 1/std=34.968
22 Std=0.0272164 1/std=36.7426
24 Std=0.0259991 1/std=38.4629
26 Std=0.0249334 1/std=40.1069
28 Std=0.0239323 1/std=41.7845
30 Std=0.0230171 1/std=43.446
1/Std Mult Average=30.8494

As one can see the RMedV Standard Deviation for N=4 is over 3 times the SD for N=30. This makes it difficult to find a range for vup and vdn that satisfy all N. We would like to find a multiplier of the RMedV that normalizes all the RMedV standard deviations for any given N to the same SDs.

Fortunately, the SDs for the different Ns for The RMedV are proportional to **√N**. So, if we multiply the RMedV by the √N, the RMedV for different N should have the same SDs and ranges. Below are the results for multiplying the RMedV by √N and computing it's standard deviation.

@CL 5 min bars Date Range 1140803 to 1160212
Total Number of Bars=108333 Sqrt(n) Norm=1
Trading Times Constraint Start Time=800 EndTime=1430
RMedVx Multiplier to Scale RMedVx N Range to One Std
4 Std=0.146815 1/std=6.81128
6 Std=0.137764 1/std=7.25878
8 Std=0.132937 1/std=7.52237
10 Std=0.131049 1/std=7.63072
12 Std=0.130034 1/std=7.69028
14 Std=0.12957 1/std=7.71786

16 Std=0.129095 1/std=7.74622
18 Std=0.128297 1/std=7.79441
20 Std=0.127892 1/std=7.81907
22 Std=0.127656 1/std=7.83354
24 Std=0.127369 1/std=7.8512
26 Std=0.127136 1/std=7.86561
28 Std=0.60638 1/std=7.89652
30 Std=0.6007 1/std=7.93212
1/Std Mult Average=7.66928

As we can see the SDs are now very close. If we multiply all RMedVs by 7.669*√N then the SDs of the velocities for all will be normalized to 1. For this case 7.669 would be the multiplier ***xmult***, in the strategy and indicator. This allows us to do an optimization search for ranges of vup and vdn from 0.2 to 3.4 standard deviations for all N.

Please note that different futures and different time bars give different multipliers.

