

Trading the Euro EC 5min Bars With The Repeated Median Velocity Strategy

1/2/2008 to 4/26/2019

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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 determine 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 meandering 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.

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

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

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 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

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

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	$y(6)-y(1)/(6-1)=$	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:

$$(y(2)-y(i))/(2-i), i=1 \text{ to } 15 \ i \neq 2,$$

$$(y(3)-y(i))/(3-i), i=1 \text{ to } 15 \ i \neq 3,$$

.....

$$(y(16)-y(i))/(16-i), i=1 \text{ to } 16 \ i \neq 16.$$

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

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

$\begin{matrix} i=1 \text{ to } N \\ j=1 \text{ to } N \end{matrix}$

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 $y = a + bx$.

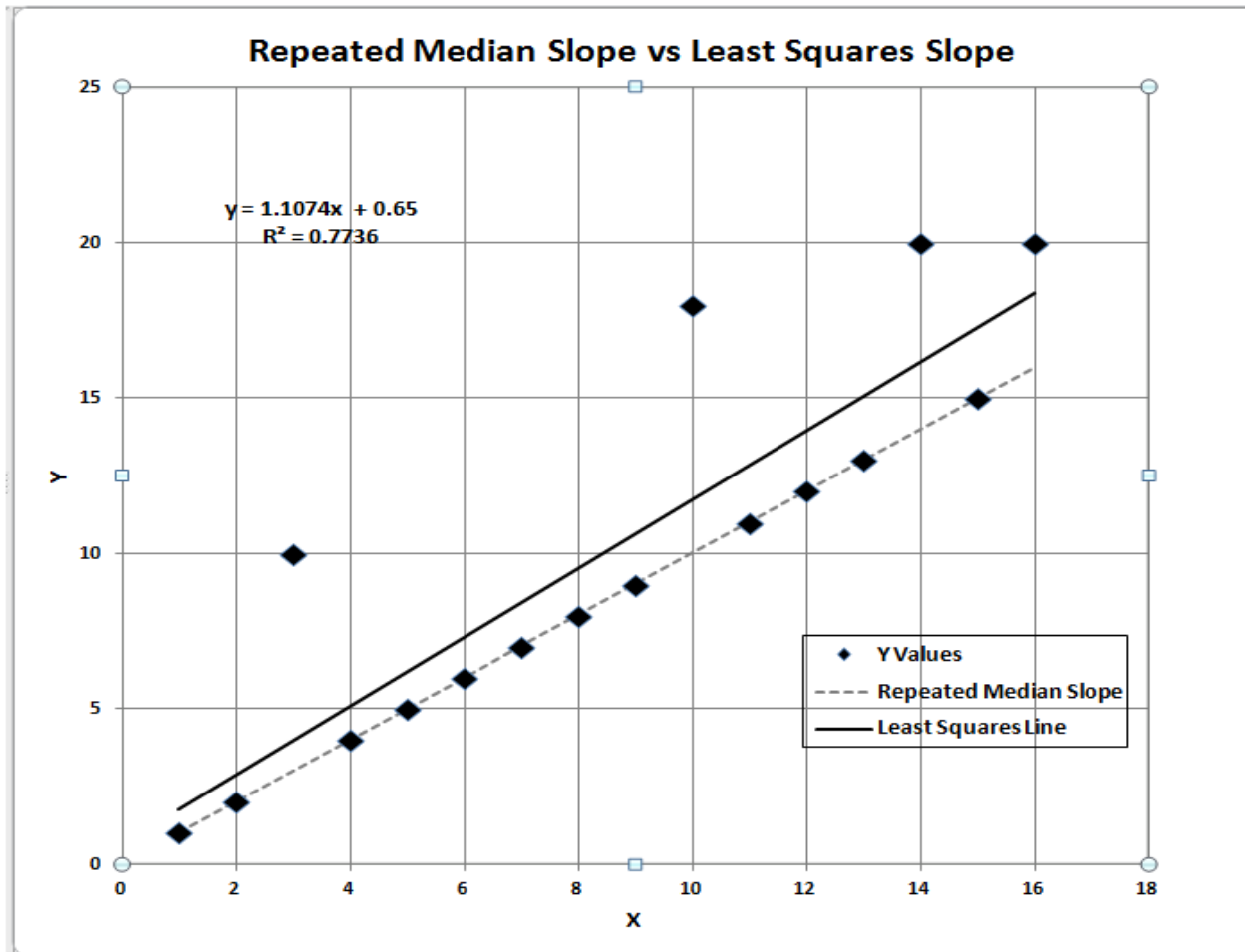


Figure 1 Repeated Median Slope vs Least Squares Slope.

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 the threshold amount *vup* then buy at the market.

Sell Rule:

IF **RMedV** is less than the threshold amount *-vdn* then sell at the market.

Friday Exit Rule:

Discussion of Euro Futures Prices

The Euro (EC) is traded on Globex. On Globex the EC is traded on a 23hour basis. On Monday Through Thursday the EC closes at 1600hr CST and reopens at 1700hr CST. On Friday the EC closes at 1600hr CST and reopens on Sunday at 1700hr CST. For this paper we will trade all hours that Globex is open, but we will close all open positions on Friday at 1600hr CST and resume trading at 1700hr on Sunday. Please note that the strategy might not have a buy or sell signal when trading opens on Sunday. To test this strategy, we will use 5-minute bar prices of the EC futures contract for the 11+ years from January 2, 2008 to April 27, 2018. We will use the 52 weeks of EC 5 min bar prices following Friday 4/27/2018, from Sunday 4/29/2018 to Friday 4/26/2019, to see how the Repeated Median Velocity out-of-sample metric filter found on the 1/1/2008 to 4/27/2018 price data performed on *future* data it had not seen.

Data Discussion

To test this strategy, we will use 5-minute bar prices of the Euro traded on Globex known by the symbol EC for the 586 weeks from January 2, 2008 to April 26, 2019.

We will test this strategy with the above EC 5min bars on a walk forward basis, as will be described below. In TradeStation (TS) or MultiCharts(MC), we will run the RMedV Strategy on the EC 5 min bar data from January 3, 2008 to December 27, 2018. We will breakup and create 30-day calendar *in-sample* sections along with their corresponding one calendar week *out-of-sample* sections from the 586 weeks of EC (see Walk forward Testing below) creating 586 out-of-sample weeks. To create our walk forward files we will use the *add-in* software product called the Power Walk Forward Optimizer (PWFO) <http://meyersanalytics.com/Walk-Forward-Optimization.html>. In TS/MC, we will run the PWFO strategy *add-in* along with the RMedV Strategy on the EC 5min data from 1/3/2008 to 4/26/2019. The PWFO will breakup and create 30-day calendar in-sample sections along with their corresponding one calendar week out-of-sample sections from the 586 weeks of EC (see Walk Forward Testing below) creating 586 out-of-sample weeks. Note the first in-sample week will be from 1/3/2008 to 2/1/2008 and the first out-of-sample week will be from 02/03/2008 to 02/08/08.

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

We will test the RMedV strategy with the above EC 5 min bars on a *walk forward basis*, as will be described below.

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

Whenever we do a TradeStation(TS) or MultiCharts(MC) optimization on a number of different strategy inputs, TS/MC generates an *in-sample* 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 (OOS) data*. Since the performance metrics generated in the in-sample section are usually 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 price data.

What do we mean by "*curve fitting*" or *data mining*? As a simple example, suppose you were taking a 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 can't observe what is in the other subway cars, you would assume that all the other subway cars and perhaps all women in general 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 input parameters from the in-sample 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 case that had the best percent profit. This procedure would leave you with one case in the in-sample section 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. 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 strategy 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 the number of out-of-sample sections 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? Surely the price noise cancels itself out with such a large number of in-sample 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 with no out-of-sample testing cause losses when traded in real time from something that looked great in the in-sample section.

In order to gain confidence that our input parameter selection method 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 gives considerable variation in week-to-week 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 Strategy Parameters Using Walk Forward Optimization

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

For the test data we will run the Multicharts64 optimization engine on **EC 5** min price bars from 1/3/2008 to 4/26/2019 with the below optimization ranges for the RMedV strategy inputs. I will create a 30-calendar day in-sample periods each followed by a 7 day out-of-sample period (See Table 1 for the in-sample/out-of-sample periods). This will create 586 in-sample 30-day periods followed by 586 out-of-sample 7-day periods from 1/3/2008 to 4/26/2019.

We will use the following strategy input optimization ranges.

N from 6 to 30 in steps of 1

vup from 0.25 to 3.5 steps of 0.25

vdn from 0.25 to 3.5 in steps of 0.25

Fri Close we will close all open positions on Friday at 1600hr CST and resume trading at 1700hr on Sunday

Mult= $1788*\sqrt{N}$. Note: this normalizes the RMedV Velocity range for each N to one standard deviation. Else the Velocity would have different ranges for different N, and it would be difficult to find a vup and vdn that worked for all N ranges. See Appendix 1 for a detailed explanation.

This will produce 4900 different input combinations or cases of the strategy input parameters. for each of the 586 in-sample/out-of-sample files for the approximately 11+ years of 5 min bar EC prices from 1/3/2008 to 4/26/2019.

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 the in-sample section will produce in-sample strategy inputs that produce statistically valid average profits in the out-of-sample section. In other words, we wish to find a performance metric *filter* that we can apply to the in-sample section that can give us strategy inputs that will produce, on average, good trading results in the future.

When TS/MC does an optimization over many combinations of inputs, it creates an output page that has as its rows each strategy input combination and as its columns various trading performance measures such as Profit Factor, Total Net Profits, etc. An example of a simple filter would be to choose the strategy input optimization row in the in-sample section that had the highest Net Profit or perhaps a row that had the best Profit Factor with their associated strategy inputs. Unfortunately, it was found that this type of simple metric performance filter very rarely produces good out-of-sample results. More complicated metric filters can produce good out-of-sample results minimizing spurious price movement biases in the in-sample selection of strategy inputs.

The combination metric filters are found by a program called WFME64v8x. Details of this program can be found at <http://meyersanalytics.com/wfme.html>.

All PWFO file metrics used by the WFME64v8x are described at <http://meyersanalytics.com/Walk-Forward-Optimization.html>.

We will use the WFME64 v8x program to find one in-sample combination-metric filter applied to each in-sample section which gives a set of strategy inputs which are then applied to each following out-of-sample section. This will consist of 534 in-sample and out-of-sample sections. We will leave the 52 sections of EC data from 4/29/18 to 4/26/2019 out of the WFME64 calculations so that we can see how the metric filters found by the WFME64 performed on these 52 following *future* weeks which was not included in the original WFME64 run.

Here is the metric combination *filter* found by the WFME64 v8x program that was used in this paper. High profit factors (**pf**) in the in-sample section usually mean poor performance in the out-of-sample-section. This is a kind of reversion to the mean. So, in the in-sample (IS) section we eliminate all strategy input rows that have the in-sample metric **pf**>2. In addition, a high **Kendall rank correlation coefficient (ktau)** in the in-sample section also usually means poor

performance in the out-of-sample-section. This is also a kind of reversion to the mean. So, in the in-sample section we eliminate all strategy input rows that have the in-sample metric **ktau>50**. Using the **pf-ktau** elimination screen, as described, there can still be 100's of rows left in the in-sample section. The PWFO generates the performance metric named **eqTrn**. This metric is **Slope of the In-Sample Trade Equity Trend Line for a given set of strategy inputs**. Let us choose the 15 rows in the in-sample section that contain the **maximum eqTrn** values from the rows that are left from the **pf-ktau** screen. In other words, we sort **eqTrn** from high to low, eliminate the rows that have **pf>2, ktau>50** and then choose the largest 15 **eqTrn** rows of whatever is left. This filter will now leave 15 cases or rows in the in-sample section that satisfy the above filter conditions. We call this filter **t15eqTrn |p≤2|ktau≤50** where **t15eqTrn** means the top or maximum **15 eqTrn** rows left *after* the **pf-ktau** in-sample row elimination. Suppose for this filter, within the 15 in-sample rows that are left, we want the row that has the highest value of the column metric called **mWb/mLb**. **mWb/mLb** is the Ratio of the Median of Winning Bars to the Median of Losing Bars for all trades in the in-sample section for a given set of strategy inputs. We abbreviate this final filter as **t15eqTrn |p≤2|ktau≤50- mWb/mLb**. For each in-sample section this filter leaves only one row in the in-sample section with its associated strategy inputs and following out-of-sample net profit in the out-of-sample section using the strategy inputs found in the in-sample section. This **t15eqTrn |p≤2|ktau≤50-mWb|mLb filter** is then applied to each of the 534 in-sample sections which give 534 sets of strategy inputs that are used to produce the corresponding 534 out-of-sample performance results. The average out-of-sample performance is calculated from these 534 out-of-sample performance results. In addition, many other important out-of-sample performance statistics for this filter are calculated and summarized.

Figure 2 shows such a computer run along with a small sample of other WFME64 filter combinations that are constructed in a similar manner. **Row 9** of the sample output in **Figure 2** shows the results of the filter discussed above.

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's 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 5000 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 2** lists the 5000-mirror filter's bootstrap average for our 534 out-of-sample files of **(\$171)** with a bootstrap standard deviation of **\$87.8**. (Side Note. The average is the average per out-of-sample period(weekly). So, the average for the random selection would be the random (Average Random toNP/534) and the average net weekly for the filter from **Figure 2, Row 9** would be the **filter toNP/ (# of OOS) periods traded** or **175645/502=349.89**. The probability of obtaining our filters average weekly net profit of **349.89** is **1.47x10⁻⁹** which is **5.9** standard

deviations from the bootstrap average. For our filter, in Row 9, the expected number of cases that we could obtain by pure chance that would match or exceed **\$349.89** is $[1-(1-1.28 \times 10^{-9})^{172980}] \approx 172980 \times 1.47 \times 10^{-9} = 0.0025$ where **172980** 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 WFME64 filter on the 534 weeks ending 2/8/2008 – 4/27/18 and the equity curve on the 52 weeks following until 4/26/2019 (note the starting date 1/2/2008 was part of the first 30 day in-sample period). 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 EC weekly closing prices superimposed on the Equity Chart. The vertical dotted red line on the right separates the future excluded period equity from 4/27/18 to 4/27/19. This is what would have happened if you used the strategy inputs found by the filter **t15eqTrn|p≤2|ktau≤50-mWb|mLb** on data not included in the initial run.

Figure 2 shows such a computer run along with a small sample of other WFME64 filter combinations that are constructed in a similar manner. **Row 9** of the sample output in **Figure 2** shows the results of the filter discussed above.

Figure 3 presents the out-of-sample EC 5-minute bar chart of all the buy and sell signals of the WFME64 filter 11/28/18 to 12/7/18 with the RMedV Indicator or those dates.

Table 1 below presents a table of the 534 plus the 52 future weeks in-sample and out-of-sample dates, the WFME **Filter** selected, strategy inputs and the weekly out-of-sample profit/loss results using the **t15eqTrn|p≤2|ktau≤50-mWb|mLb** filter described above.

Discussion of Strategy Performance of the WFME64 run

In **Figure 2, Row 9** is the filter chosen, **t15eqTrn|p≤2|ktau≤50-mWb|mLb**. This Metric Filter produced \$175,645 net profits after costs in 534 weeks and \$14005 net profits after costs in the withheld 52 weeks from the initial WFME run. The spreadsheet columns present some statistics that are of interest for the filter. An interesting statistic is **Blw**. **Blw** is the maximum number of weeks the **OOS** equity curve for this filter failed to make a new high. **Blw** is 53 weeks for this filter. This means that 53 weeks was the longest time that the equity for this strategy failed to make a new equity high in the 534 out-of-sample weeks. For this strategy, the **%P** (% of weekly oos periods that are positive) was **53%**, and the **%Wtr** (The % of all oos trades that are positive) was **45%**. This low **%Wtr** was made up for by **oW/oL** (average oos winning trades/average oos losing trades) equal to 1.67.

To see the effect of walk forward analysis, look at **Table 1**. Notice how the input parameters **N**, **vup**, **vdn** take sudden jumps from high to low and back. This is the walk forward process quickly adapting to changing volatility conditions in the in-sample sample. In addition, notice how often **N** changes from 6 to 30. When the data gets very noisy with a lot of spurious price

movements, the look back period, N, should be higher. During other times when the noise level is not as much N can be lower to get onboard a trend faster.

Figure 1 presents a graph of the equity curve using the **t15eqTrn|p≤2|ktau≤50-mWb|mLb filter** on the 534 weeks of out-of-sample data. Notice how the equity curve follows the 2nd order polynomial trend line with an R² of 0.96. This R² dropped to 0.95 for the net equity curve.

Using this filter, the strategy generated a profit of \$189,650 net equity after commissions and slippage of \$20/trade trading one EC contract for the total 586 weeks. From **Table 1**, the largest losing week was -\$7100 on the week ending 11/21/2008. The largest drawdown was -\$14590 from the week ending on 6/12/09 to 4/2/10. This drawdown lasted 42 weeks and took 6 weeks to recover and make a new equity. The second largest drawdown was -\$11620 from the week ending on 11/11/16 to 4/28/17. This drawdown lasted 24 weeks and took 27 weeks to recover and make a new equity. The *future* period that was not included in the WFME64 run from 4/29/18 to 4/26/19 was a volatile down market yet the RMedV strategy/WFME filter did well making a net profit of \$14005 during that one-year time frame.

Lastly, as can be seen in **Figure 2**, the top 15 filters all did very well in the 52 *future* weeks from 4/27/18 to 4/26/5019 following the original analysis.

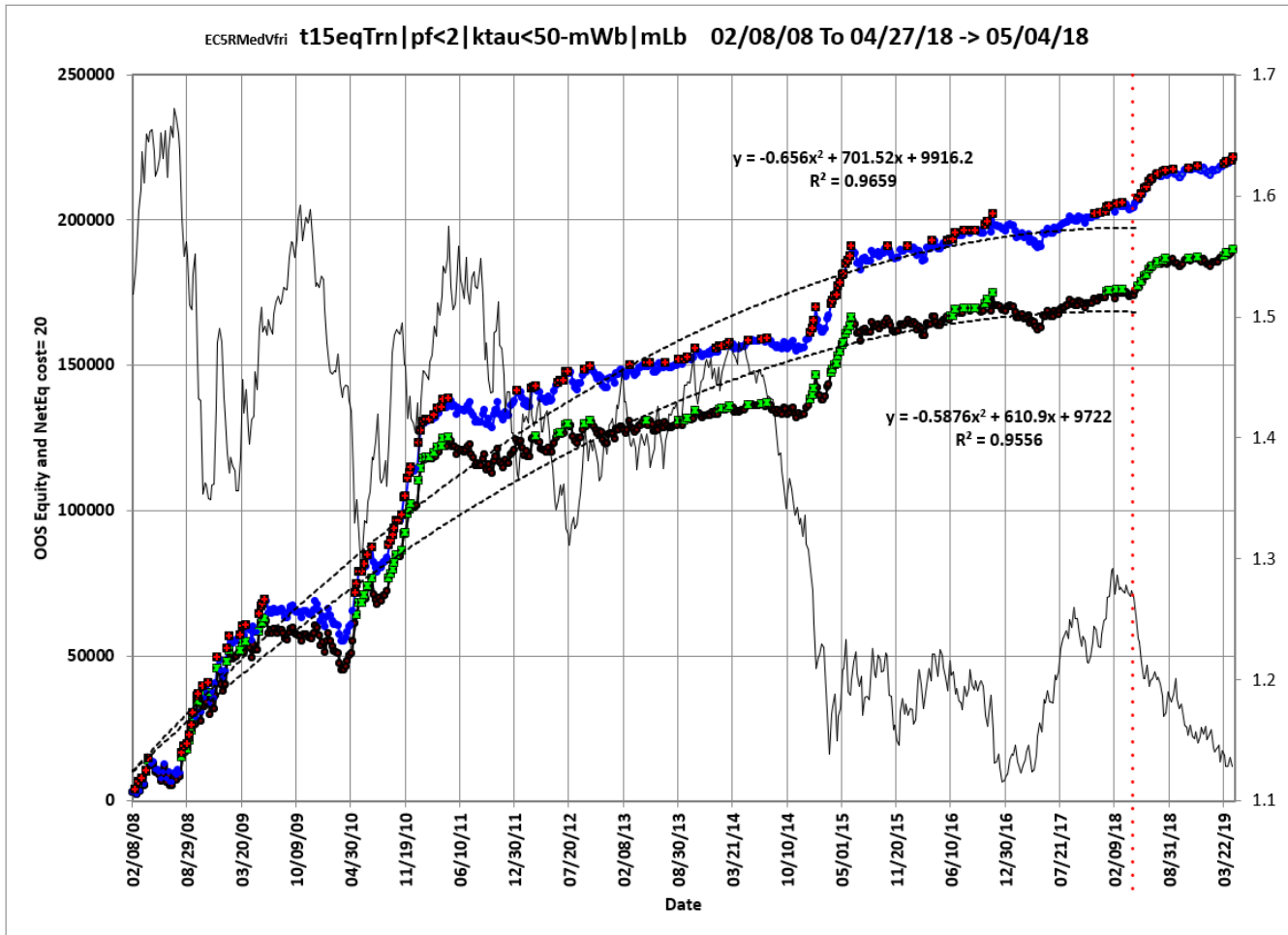
In observing Table 1 we can see that this strategy and filter made trades from a low of no trades in 32 of the 534 weeks to a high of 21 trades/week with an average of 3 trades/week in the weeks it did trade.

References

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Figure 1 Graph of RMedV Strategy OOS Net Equity Applying the WFME64 Filter Each Week to In-Sample RMedV EC5min Bar Prices 2/08/2008 to 4/27/2018 >>4/26/2019

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 of \$20/round trip trade and the green dots are the new highs in net equity. The grey line is the EC Weekly Closing prices superimposed on the Equity Chart. The vertical dotted red line on the right separates the future excluded period equity from 4/29/18 to 4/26/19. This is what would have happened if you used $t15eqTrn|p\leq 2|k\tau\leq 50-mWb|mLb$ filter on future data 4/29/2018-4/26/19 which was not included in the WFME filter run.



**Figure 2 Partial output of the Walk Forward Metric Explorer (WFME64 v8X)
EC 5 min bars RMedV Velocity Strategy**

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	EC5RMedVfri	s02/08/08	e04/27/18	#534	AnyTnp	#52							
2	Filter-Metric	toGP	toNP	aoGP	aoTr	ao#T	std	skew	kur	t	oW oL	%Wtr	%P
3	t05eqTrn pf<2 lr<5ktau<50-eqTrn	208943	182863	415	160.2	2.6	2228	0.455	5.66	4.18	1.67	45	56
4	t30eqTrn pf<2 lr<5ktau<50-eqTrn	208943	182863	415	160.2	2.6	2228	0.455	5.66	4.18	1.67	45	56
5	t15eqTrn pf<2 lr<5ktau<50-eqTrn	208943	182863	415	160.2	2.6	2228	0.455	5.66	4.18	1.67	45	56
6	t15eqTrn pf<2 ktau<60-m(ru-p)	213717	179077	418	123.4	3.4	2219	0.543	4.91	4.26	1.69	44	55
7	t05eqTrn pf<2 -mDev	203657	178817	442	164.0	2.7	2275	0.281	6.35	4.17	1.71	45	56
8	t15eqTrn pf<2 ktau<50-tWb	208373	176453	399	130.6	3.1	2122	0.593	4.88	4.3	1.58	46	53
9	t15eqTrn pf<2 ktau<50-mWb mLb	205665	175645	410	137.0	3	2160	0.595	5.05	4.25	1.67	45	53
10	t05eqTrn pf<2 ktau<80-mDev	201816	175196	409	151.6	2.7	2228	0.331	6.46	4.08	1.72	44	55
11	t05eqTrn pf<2 ktau<70-mDev	199347	172287	401	147.3	2.7	2224	0.315	6.47	4.02	1.72	44	54
12	t05eqTrn pf<2 lr<5ktau<60-std	201493	171813	401	135.8	3	2188	0.603	6.39	4.11	1.69	44	55
13	t15eqTrn pf<2 ktau<50-mLb	203745	170545	407	122.7	3.3	2216	0.693	5.63	4.11	1.71	44	54
14	t05eqTrn pf<2 lr<5ktau<50-mWb mLb	198627	170507	396	141.3	2.8	2263	0.442	5.08	3.92	1.69	44	54
15	t30eqTrn pf<2 ktau<50-eq2b1	198016	169056	391	136.8	2.9	2244	0.202	5.43	3.92	1.66	45	54
16	t15eqTrn pf<2 ktau<60-eqR2	202405	168645	397	119.9	3.3	2205	0.518	7.6	4.06	1.67	44	54
17	t15eqTrn pf<2 ktau<50-tnp	204435	167795	393	111.6	3.5	2151	0.707	4.83	4.17	1.66	44	54

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	a(171.0)	s87.8	f172980					c=\$20							s05/04/18	e04/26/19	#52				t586
2	LlTr	LlP	eqDD	wpr	lpr	#	V20	Dev^2	KTau	eqR2	Blw	BE	tkr bl		toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet	Prob
3	-4050	-10150	-21214	9	7	504	169	20992	92	88	55	129	611		15136	13776	223	1.5	44	196639	5.93E-10
4	-4050	-10150	-21214	9	7	504	169	20992	92	88	55	129	611		15136	13776	223	1.5	44	196639	5.93E-10
5	-4050	-10150	-21214	9	7	504	169	20992	92	88	55	129	611		15136	13776	223	1.5	44	196639	5.93E-10
6	-4675	-7463	-20678	9	6	511	21	27254	84	83	140	124	212		13831	12431	198	1.6	44	191508	1.42E-09
7	-4275	-11800	-11825	9	7	461	200	21885	85	84	147	129	201		3313	2333	68	1.4	35	181150	9.58E-11
8	-4738	-7138	-18412	16	7	522	181	20407	91	88	68	121	508		8718	6878	95	1.9	49	183331	3.32E-09
9	-4038	-7100	-14590	16	8	502	109	17448	93	91	53	124	679		15745	14005	181	1.9	47	189650	1.47E-09
10	-4013	-11800	-12299	9	7	494	113	23269	83	83	130	135	216		15047	13727	228	1.7	39	188923	1.06E-09
11	-4013	-11800	-12848	9	7	497	68	21439	83	85	146	139	194		13471	12171	207	1.6	40	184458	1.84E-09
12	-4050	-9425	-14288	11	8	503	79	22148	87	84	60	133	501		9668	8188	131	1.7	43	180001	2.61E-09
13	-3875	-7138	-17602	14	8	500	4	24159	83	83	151	133	188		13393	11793	167	1.8	44	182338	2.70E-09
14	-4038	-10075	-15262	14	7	502	152	21888	90	85	67	146	446		10341	8881	142	1.6	46	179388	2.97E-09
15	-4163	-9525	-17320	8	8	507	178	22154	90	85	94	146	317		13855	12335	182	1.6	48	181391	4.53E-09

The WFME64 v8X AVE File Output Cols are defined as follows

❖ **Row 1 Columns:**

A=The PWFO Stub, **B**=File Start Date, **C**=File End Date, **D**= Number of oos periods (in this example weeks), **N**= Bootstrap average, **O**= Bootstrap Standard Deviation, **P**=Number of filters run, **U**= Cost and slippage per trade

❖ **Row 1 and Row 2 Columns AA, AB,AC,AD,AE** Future Results Not Included in the WFME64 Run. These set of results show how it would turn out if the Strategy Inputs/Filter was used on pwfo files not included in the WFME64 run.

Row 1 Col AB: Future PWFO File Start Date

Row 1 Col AC: Future PWFO File End Date

Row 1 Col AD: Future Number of PWFO Files not included in the WFME64 run (in this example weeks)

Row 1 Col AH: Number of Total oos+future PWFO Files

❖ **Row 2 to Last Row Columns: A through AH**

Col A: *The Strategy Input/Filter Names* Example Row 9: *t50mLTr|lr<3r2<80|nt>5-mDev.*

Col B: *toGP* - Total out-of-sample(oos) gross profit for these 347 oos periods (= weeks).

Col C: *toNP* - Total out-of-sample(oos) Net profit (toGP-Number of Trade Weeks*cost) for the 347 oos periods.

Col D: *aoGP* - Average oos gross profit for the 347 oos periods
Col E: *aoTr* - Average oos profit per trade
Col F: *ao#T* - Average number of oos trades per week
Col G: *std* - he standard deviation of the 347 oos period profits and losses
Col H: *skew* - The Skew statistic of the 347 oos period profits and losses
Col I: *kur* - he kurtosis statistic of the 347 oos period profits and losses
Col J: *t* - The student t statistic for the 347 oos periods. The higher the t statistic the higher the probability that this result was not due to pure chance
Col K: *oW/oL* - Ratio of average oos winning trades divided by average oos losing trades.
Col L: *%Wtr* - he percentage if oos winning trades
Col M: *%P* - percent of all oos periods that were profitable.
Col N: *LLtr* - The largest losing oos trade in all oos periods
Col O: *LLp* - The largest losing oos period
Col P: *eqDD* - The oos equity drawdown
Col Q: *wpr* - The largest number of winning oos periods (weeks) in a row.
Col R: *lpr* - he largest number of losing oos periods in a row
Col S: *#* - The number of oos periods this filter produced any profit or loss. Note for some oos periods there can be no strategy inputs that satisfy a given filters criteria and no trades will be made during that period.
Col T: *eqA2* - The acceleration of a 2nd order polynomial fit to the oos equity curve.
Col U: *Dev^2* - measure of equity curve smoothness. The square root of the average (equity curve minus a straight line)^2)
Col V: *KTau^2* - 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 W: *eqR2* - The correlation coefficient(R^2) of a straight line fit to the equity curve.
Col X: *Blw* - The maximum number of oos periods the oos equity curve failed to make a new high.
Col Y: *BE* - Break even in oos periods. Assuming the average and standard deviation are from a normal distribution, this is the number of oos periods you would have to trade to have a 98% probability that your oos equity is above zero.
Col Z: *tkr/bl* = $t * ktau * eqR2 / Blw$ a measure of how good the filter fit is.
Col AB: *toGPx* Total gross profit for the 52 future excluded periods (for this run periods = weeks).
Col AC: *toNPx* Total Net profit (toGP-Number of Trade Weeks(#x)*cost) for the 52 future excluded periods.
Col AD: *aoTrx* Average profit per trade for the 52 future excluded periods
Col AE: *aoNTx* Average number of trades per week for the 52 future excluded periods
Col AF: *#x* The number of the 52 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 AG: *tOnpNet* - toNP+toNPx = Total Net Profits of oos+future periods
Col AH: *Prob* - The probability that the filters toNP was due to pure chance.

**Figure 3 The out-of-sample 5-minute bar chart of all the RMedV Strategy buy and sell signals of the WFME64 filter with the RMedV Indicator.
4/9/19 to 4/26/19**



**Table 1 Walk Forward Out-Of-Sample Performance Summary
EC-5 min bars RMedV Strategy with WFME64 Filter**

EC 5 min bars 1/2/2008 - 4/26/19 OOS weekly performance using the below filter on each in-sample segment. The input values *N*, *vup*, *vdn* are the values found from applying the filter to the in-sample section.

In-sample Section Filter: $t15eqTrn|p \leq 2|k\tau \leq 50 - mWb|mLb$

Where:

osp = Weekly Out-of-sample gross profit in \$

ont = The number of trades in the out-of-sample week.

ollt = The largest losing trade in the out-of-sample section in \$.

odd = The drawdown in the out-of-sample section in \$.

Equity = Running Sum of weekly out-of-sample gross profits \$

osnp\$20 = Weekly Out-Of-Sample Net Profit in \$ = **osp-ont*20**

NetEq = running sum of the weekly out-of-sample net profits (osnp\$20) in \$

N = N the lookback period

vup, the threshold amount that velocity has to be greater than to issue a buy signal

vdn, the threshold amount that velocity has to be less than to issue a sell signal

Note: Blank rows indicate that no out-of-sample trades were made that week

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
1/3/2008	2/1/2008	2/3/2008	2/8/2008	2963	2	0	0	2963	2923	2923	24	1.5	2.75
1/10/2008	2/8/2008	2/10/2008	2/15/2008	1138	1	0	0	4101	1118	4041	21	2	3
1/17/2008	2/15/2008	2/17/2008	2/22/2008	(1938)	2	2100	-2100	2163	(1978)	2063	29	3	3
1/24/2008	2/22/2008	2/24/2008	2/29/2008	4263	1	0	0	6426	4243	6306	9	3.25	3
1/31/2008	2/29/2008	3/2/2008	3/7/2008	(3038)	2	2075	-3038	3388	(3078)	3228	26	3.25	2.75
2/7/2008	3/7/2008	3/9/2008	3/14/2008	4200	3	-200	-200	7588	4140	7368	29	1.25	2.25
2/14/2008	3/14/2008	3/16/2008	3/21/2008	(1950)	13	-938	-3025	5638	(2210)	5158	30	1.25	2
2/21/2008	3/21/2008	3/23/2008	3/28/2008	4963	1	0	0	10601	4943	10101	22	2	3
2/28/2008	3/28/2008	3/30/2008	4/4/2008	4000	2	0	0	14601	3960	14061	30	3.5	2.75
3/6/2008	4/4/2008	4/6/2008	4/11/2008	(625)	2	-463	-625	13976	(665)	13396	19	3.5	3.5
3/13/2008	4/11/2008	4/13/2008	4/18/2008	(1350)	3	2775	-2775	12626	(1410)	11986	19	3.25	1.5
3/20/2008	4/18/2008	4/20/2008	4/25/2008	713	3	1288	-1288	13339	653	12639	23	1.5	3.5
3/27/2008	4/25/2008	4/27/2008	5/2/2008	(2600)	4	1463	-2600	10739	(2680)	9959	29	0.25	3.5
4/3/2008	5/2/2008	5/4/2008	5/9/2008	(88)	1	-88	-88	10651	(108)	9851	17	1.5	3.25
4/10/2008	5/9/2008	5/11/2008	5/16/2008	(738)	2	1038	-1038	9913	(778)	9073	30	2.5	2.25
4/17/2008	5/16/2008	5/18/2008	5/23/2008	(2400)	2	2875	-2875	7513	(2440)	6633	30	3.5	2.75
4/24/2008	5/23/2008	5/25/2008	5/30/2008	2338	1	0	0	9851	2318	8951	19	2.75	3.5
5/1/2008	5/30/2008	6/1/2008	6/6/2008	2850	3	1850	-1850	12701	2790	11741	17	1.75	3.5
5/8/2008	6/6/2008	6/8/2008	6/13/2008	(5075)	7	2788	-5163	7626	(5215)	6526	14	2	3.5
5/15/2008	6/13/2008	6/15/2008	6/20/2008	2113	1	0	0	9739	2093	8619	20	2.5	3.25
5/22/2008	6/20/2008	6/22/2008	6/27/2008	(3375)	3	1788	-3375	6364	(3435)	5184	30	2.75	1.25
5/29/2008	6/27/2008	6/29/2008	7/4/2008	38	2	-675	-675	6402	(2)	5182	30	2	3
6/5/2008	7/4/2008	7/6/2008	7/11/2008	2963	1	0	0	9365	2943	8125	18	2.5	3
6/12/2008	7/11/2008	7/13/2008	7/18/2008	(825)	3	-538	-825	8540	(885)	7240	15	1.25	3.5
6/19/2008	7/18/2008	7/20/2008	7/25/2008	2100	1	0	0	10640	2080	9320	30	3.25	2
6/26/2008	7/25/2008	7/27/2008	8/1/2008	(1075)	3	1075	-1900	9565	(1135)	8185	19	3.5	2
7/3/2008	8/1/2008	8/3/2008	8/8/2008	6950	1	0	0	16515	6930	15115	20	2.5	2.5
7/10/2008	8/8/2008	8/10/2008	8/15/2008	2400	13	1100	-1663	18915	2140	17255	10	2.75	1.25

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
7/17/2008	8/15/2008	8/17/2008	8/22/2008	(463)	3	-613	-1175	18452	(523)	16732	27	2.25	2.75
7/24/2008	8/22/2008	8/24/2008	8/29/2008	1050	3	0	0	19502	990	17722	24	3	2
7/31/2008	8/29/2008	8/31/2008	9/5/2008	3113	3	-688	-800	22615	3053	20775	24	3.25	2.5
8/7/2008	9/5/2008	9/7/2008	9/12/2008	3650	9	1375	-3250	26265	3470	24245	25	1.5	3.25
8/14/2008	9/12/2008	9/14/2008	9/19/2008	3938	9	1475	-4150	30203	3758	28003	30	3	3.5
8/21/2008	9/19/2008	9/21/2008	9/26/2008	(1638)	5	1675	-4138	28565	(1738)	26265	24	1.75	3.5
8/28/2008	9/26/2008	9/28/2008	10/3/2008	7675	4	-700	-700	36240	7595	33860	27	2.75	3.25
9/4/2008	10/3/2008	10/5/2008	10/10/2008	625	11	1500	-3350	36865	405	34265	29	3	3
9/11/2008	10/10/2008	10/12/2008	10/17/2008	(6488)	10	1938	-7188	30377	(6688)	27577	28	3	3.25
9/18/2008	10/17/2008	10/19/2008	10/24/2008	9163	5	-388	-388	39540	9063	36640	28	3.5	2
9/25/2008	10/24/2008	10/26/2008	10/31/2008	(3938)	15	2950	10163	35602	(4238)	32402	29	3.5	2.5
10/2/2008	10/31/2008	11/2/2008	11/7/2008	1763	10	2713	-5788	37365	1563	33965	28	3.5	0.25
10/9/2008	11/7/2008	11/9/2008	11/14/2008	3350	8	4038	-4038	40715	3190	37155	28	3.5	0.25
10/16/2008	11/14/2008	11/16/2008	11/21/2008	(7100)	6	2275	-7100	33615	(7220)	29935	29	3.5	3.5
10/23/2008	11/21/2008	11/23/2008	11/28/2008	3713	2	0	0	37328	3673	33608	29	3.5	3.5
10/30/2008	11/28/2008	11/30/2008	12/5/2008	(1975)	3	1300	-1975	35353	(2035)	31573	27	3.5	3.5
11/6/2008	12/5/2008	12/7/2008	12/12/2008	4950	5	-825	-1238	40303	4850	36423	29	0.75	3.5
11/13/2008	12/12/2008	12/14/2008	12/19/2008	9325	12	2813	-4575	49628	9085	45508	28	0.25	3.5
11/20/2008	12/19/2008	12/21/2008	12/26/2008	(988)	3	1238	-1875	48640	(1048)	44460	23	2	3.5
11/27/2008	12/26/2008	12/28/2008	1/2/2009	(4013)	10	1538	-7188	44627	(4213)	40247	27	2.5	3.25
12/4/2008	1/2/2009	1/4/2009	1/9/2009	(2225)	10	3188	-4538	42402	(2425)	37822	28	1.5	3.25
12/11/2008	1/9/2009	1/11/2009	1/16/2009	2325	3	-925	-925	44727	2265	40087	29	3.25	2.5
12/18/2008	1/16/2009	1/18/2009	1/23/2009	7975	8	-75	-75	52702	7815	47902	24	3.5	0.25
12/25/2008	1/23/2009	1/25/2009	1/30/2009	3875	9	-988	-2700	56577	3695	51597	24	3.5	1
1/1/2009	1/30/2009	2/1/2009	2/6/2009	(875)	7	2050	-2963	55702	(1015)	50582	29	3.25	1.25
1/8/2009	2/6/2009	2/8/2009	2/13/2009	(1550)	6	1338	-2325	54152	(1670)	48912	28	3.5	0.5
1/15/2009	2/13/2009	2/15/2009	2/20/2009	663	2	0	0	54815	623	49535	22	3.5	2.5
1/22/2009	2/20/2009	2/22/2009	2/27/2009	213	5	1063	-1063	55028	113	49648	18	3	2.75
1/29/2009	2/27/2009	3/1/2009	3/6/2009	1125	3	-188	-188	56153	1065	50713	23	3.25	3.25
2/5/2009	3/6/2009	3/8/2009	3/13/2009	1138	3	-775	-1413	57291	1078	51791	11	3.5	3.5
2/12/2009	3/13/2009	3/15/2009	3/20/2009	2938	6	2250	-2250	60229	2818	54609	19	2.75	2.75
2/19/2009	3/20/2009	3/22/2009	3/27/2009	(3288)	7	2200	-4488	56941	(3428)	51181	30	0.25	3.5
2/26/2009	3/27/2009	3/29/2009	4/3/2009	3588	1	0	0	60529	3568	54749	29	1	3.5
3/5/2009	4/3/2009	4/5/2009	4/10/2009	(700)	3	1663	-1663	59829	(760)	53989	29	2.75	3.5
3/12/2009	4/10/2009	4/12/2009	4/17/2009	(1163)	3	1613	-2925	58666	(1223)	52766	29	2.5	3.5
3/19/2009	4/17/2009	4/19/2009	4/24/2009	(3513)	3	2888	-3513	55153	(3573)	49193	29	3.25	2
3/26/2009	4/24/2009	4/26/2009	5/1/2009	4788	3	1763	-1763	59941	4728	53921	28	3.5	0.5
4/2/2009	5/1/2009	5/3/2009	5/8/2009	(1925)	7	1338	-3775	58016	(2065)	51856	17	3.5	2.25
4/9/2009	5/8/2009	5/10/2009	5/15/2009	188	3	-575	-925	58204	128	51984	19	2.5	2
4/16/2009	5/15/2009	5/17/2009	5/22/2009	6275	1	0	0	64479	6255	58239	21	0.25	3.5

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
4/23/2009	5/22/2009	5/24/2009	5/29/2009	2650	4	-525	-850	67129	2570	60809	30	2	2.25
4/30/2009	5/29/2009	5/31/2009	6/5/2009	775	10	1063	-2638	67904	575	61384	13	2.75	3.5
5/7/2009	6/5/2009	6/7/2009	6/12/2009	1513	5	1188	-1188	69417	1413	62797	26	0.5	3
5/14/2009	6/12/2009	6/14/2009	6/19/2009	(675)	3	1188	-1825	68742	(735)	62062	30	1.5	3
5/21/2009	6/19/2009	6/21/2009	6/26/2009	(4313)	2	2363	-4313	64429	(4353)	57709	26	3.25	3.25
5/28/2009	6/26/2009	6/28/2009	7/3/2009	1100	4	-925	-925	65529	1020	58729	30	3.25	0.25
6/4/2009	7/3/2009	7/5/2009	7/10/2009	(1100)	3	1313	-1700	64429	(1160)	57569	7	2.75	3.5
6/11/2009	7/10/2009	7/12/2009	7/17/2009	1700	1	0	0	66129	1680	59249	21	1	3.25
6/18/2009	7/17/2009	7/19/2009	7/24/2009	(1188)	6	1150	-2338	64941	(1308)	57941	6	2.75	3.25
6/25/2009	7/24/2009	7/26/2009	7/31/2009	(75)	7	1638	-2650	64866	(215)	57726	7	0.75	3.5
7/2/2009	7/31/2009	8/2/2009	8/7/2009	1013	2	-50	-50	65879	973	58699	29	1.75	3.5
7/9/2009	8/7/2009	8/9/2009	8/14/2009	213	1	0	0	66092	193	58892	18	0.5	3
7/16/2009	8/14/2009	8/16/2009	8/21/2009	(1138)	6	-650	-1138	64954	(1258)	57634	27	2.25	0.5
7/23/2009	8/21/2009	8/23/2009	8/28/2009	(1775)	4	1400	-1900	63179	(1855)	55779	16	1.25	3
7/30/2009	8/28/2009	8/30/2009	9/4/2009	(200)	3	-800	-800	62979	(260)	55519	8	3.25	2.5
8/6/2009	9/4/2009	9/6/2009	9/11/2009	2438	1	0	0	65417	2418	57937	19	1.25	3.5
8/13/2009	9/11/2009	9/13/2009	9/18/2009	1450	1	0	0	66867	1430	59367	7	0.75	3.5
8/20/2009	9/18/2009	9/20/2009	9/25/2009	350	14	-813	-1313	67217	70	59437	14	0.25	2.25
8/27/2009	9/25/2009	9/27/2009	10/2/2009	(1675)	4	1275	-1713	65542	(1755)	57682	22	2.25	3.25
9/3/2009	10/2/2009	10/4/2009	10/9/2009	(475)	1	-475	-475	65067	(495)	57187	27	3	3.25
9/10/2009	10/9/2009	10/11/2009	10/16/2009	(263)	1	-263	-263	64804	(283)	56904	17	3.5	2.75
9/17/2009	10/16/2009	10/18/2009	10/23/2009	200	1	0	0	65004	180	57084	22	3.25	2.75
9/24/2009	10/23/2009	10/25/2009	10/30/2009	(2013)	6	1313	-2550	62991	(2133)	54951	10	0.75	3.5
10/1/2009	10/30/2009	11/1/2009	11/6/2009	2225	3	-863	-863	65216	2165	57116	21	1.75	3
10/8/2009	11/6/2009	11/8/2009	11/13/2009	0	0	0	0	65216	0	57116	29	3	3.25
10/15/2009	11/13/2009	11/15/2009	11/20/2009	(525)	1	-525	-525	64691	(545)	56571	30	3.25	2.75
10/22/2009	11/20/2009	11/22/2009	11/27/2009	(413)	3	-275	-413	64278	(473)	56098	28	3.5	0.5
10/29/2009	11/27/2009	11/29/2009	12/4/2009	(188)	2	1375	-1375	64090	(228)	55870	27	1.5	3.25
11/5/2009	12/4/2009	12/6/2009	12/11/2009	1763	3	-675	-813	65853	1703	57573	24	3	0.75
11/12/2009	12/11/2009	12/13/2009	12/18/2009	2813	1	0	0	68666	2793	60366	28	3	3
11/19/2009	12/18/2009	12/20/2009	12/25/2009	(925)	1	-925	-925	67741	(945)	59421	14	2.75	1.75
11/26/2009	12/25/2009	12/27/2009	1/1/2010	(2600)	3	1513	-2525	65141	(2660)	56761	12	3.5	2.5
12/3/2009	1/1/2010	1/3/2010	1/8/2010	(3350)	3	1250	-3350	61791	(3410)	53351	14	3.5	3.25
12/10/2009	1/8/2010	1/10/2010	1/15/2010	1438	4	-875	-1038	63229	1358	54709	19	2.25	0.75
12/17/2009	1/15/2010	1/17/2010	1/22/2010	(3263)	7	2300	-3900	59966	(3403)	51306	16	0.75	2.75
12/24/2009	1/22/2010	1/24/2010	1/29/2010	3625	1	0	0	63591	3605	54911	24	3.5	0.25
12/31/2009	1/29/2010	1/31/2010	2/5/2010	2600	1	0	0	66191	2580	57491	10	3.5	1.75
1/7/2010	2/5/2010	2/7/2010	2/12/2010	(2425)	10	1338	-2425	63766	(2625)	54866	11	2.75	2.5
1/14/2010	2/12/2010	2/14/2010	2/19/2010	(1850)	5	1350	-2513	61916	(1950)	52916	10	2.75	3.5
1/21/2010	2/19/2010	2/21/2010	2/26/2010	(1163)	3	-500	-1163	60753	(1223)	51693	21	2.75	0.5
1/28/2010	2/26/2010	2/28/2010	3/5/2010	(38)	21	-875	-3838	60715	(458)	51235	7	2.25	2
2/4/2010	3/5/2010	3/7/2010	3/12/2010	(225)	5	1425	-1425	60490	(325)	50910	9	2.5	2
2/11/2010	3/12/2010	3/14/2010	3/19/2010	(3350)	3	1900	-3350	57140	(3410)	47500	24	0.75	3.25
2/18/2010	3/19/2010	3/21/2010	3/26/2010	(2263)	3	1988	-2338	54877	(2323)	45177	18	2.25	3.5

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
2/25/2010	3/26/2010	3/28/2010	4/2/2010	(50)	1	-50	-50	54827	(70)	45107	30	2.25	3.5
3/4/2010	4/2/2010	4/4/2010	4/9/2010	1188	2	0	0	56015	1148	46255	13	3.25	2.5
3/11/2010	4/9/2010	4/11/2010	4/16/2010	2038	2	0	0	58053	1998	48253	13	3.25	0.5
3/18/2010	4/16/2010	4/18/2010	4/23/2010	1950	6	-538	-613	60003	1830	50083	8	2.5	2
3/25/2010	4/23/2010	4/25/2010	4/30/2010	788	1	0	0	60791	768	50851	29	2.5	0.25
4/1/2010	4/30/2010	5/2/2010	5/7/2010	4450	21	-875	-3025	65241	4030	54881	8	3.25	1.5
4/8/2010	5/7/2010	5/9/2010	5/14/2010	6413	4	1525	-1525	71654	6333	61214	15	3.5	3.25
4/15/2010	5/14/2010	5/16/2010	5/21/2010	2975	8	-588	-588	74629	2815	64029	13	3.25	3.25
4/22/2010	5/21/2010	5/23/2010	5/28/2010	4263	6	1025	-1263	78892	4143	68172	30	3.5	0.5
4/29/2010	5/28/2010	5/30/2010	6/4/2010	(150)	3	1500	-1950	78742	(210)	67962	15	2.75	3.5
5/6/2010	6/4/2010	6/6/2010	6/11/2010	300	2	-675	-675	79042	260	68222	12	2.25	3.5
5/13/2010	6/11/2010	6/13/2010	6/18/2010	2500	1	0	0	81542	2480	70702	17	2	3.5
5/20/2010	6/18/2010	6/20/2010	6/25/2010	(938)	4	-813	-1413	80604	(1018)	69684	30	2	2.5
5/27/2010	6/25/2010	6/27/2010	7/2/2010	4213	1	0	0	84817	4193	73877	19	1.5	3.5
6/3/2010	7/2/2010	7/4/2010	7/9/2010	(613)	2	-375	-613	84204	(653)	73224	25	2.5	3
6/10/2010	7/9/2010	7/11/2010	7/16/2010	3275	1	0	0	87479	3255	76479	28	3.25	2.25
6/17/2010	7/16/2010	7/18/2010	7/23/2010	(5375)	7	1600	-5375	82104	(5515)	70964	6	3.25	3.5
6/24/2010	7/23/2010	7/25/2010	7/30/2010	(1688)	2	1000	-1688	80416	(1728)	69236	10	3.5	3.5
7/1/2010	7/30/2010	8/1/2010	8/6/2010	(1563)	5	1213	-2113	78853	(1663)	67573	18	2	2
7/8/2010	8/6/2010	8/8/2010	8/13/2010	2313	3	1163	-2175	81166	2253	69826	26	2.25	2.25
7/15/2010	8/13/2010	8/15/2010	8/20/2010	(825)	7	-888	-1863	80341	(965)	68861	23	1	2.75
7/22/2010	8/20/2010	8/22/2010	8/27/2010	1975	2	0	0	82316	1935	70796	25	1.25	2.75
7/29/2010	8/27/2010	8/29/2010	9/3/2010	0	0	0	0	82316	0	70796	30	3.5	2.5
8/5/2010	9/3/2010	9/5/2010	9/10/2010	1563	1	0	0	83879	1543	72339	26	3.25	2.25
8/12/2010	9/10/2010	9/12/2010	9/17/2010	4188	1	0	0	88067	4168	76507	17	2	3.5
8/19/2010	9/17/2010	9/19/2010	9/24/2010	1663	3	-775	-775	89730	1603	78110	9	3	2.75
8/26/2010	9/24/2010	9/26/2010	10/1/2010	1788	5	1150	-2238	91518	1688	79798	19	1.5	2
9/2/2010	10/1/2010	10/3/2010	10/8/2010	2175	2	0	0	93693	2135	81933	23	3.5	3
9/9/2010	10/8/2010	10/10/2010	10/15/2010	2688	4	1163	-1163	96381	2608	84541	8	2.75	3.25
9/16/2010	10/15/2010	10/17/2010	10/22/2010	288	18	1050	-1750	96669	(72)	84469	11	1.25	2.75
9/23/2010	10/22/2010	10/24/2010	10/29/2010	(425)	1	-425	-425	96244	(445)	84024	17	1.75	3
9/30/2010	10/29/2010	10/31/2010	11/5/2010	2238	2	0	0	98482	2198	86222	15	3	3.5
10/7/2010	11/5/2010	11/7/2010	11/12/2010	5988	9	-263	-263	104470	5808	92030	9	3.25	1.75
10/14/2010	11/12/2010	11/14/2010	11/19/2010	425	1	0	0	104895	405	92435	23	3.5	0.75
10/21/2010	11/19/2010	11/21/2010	11/26/2010	6200	1	0	0	111095	6180	98615	20	3.5	1.25
10/28/2010	11/26/2010	11/28/2010	12/3/2010	1788	4	1088	-1688	112883	1708	100323	25	3.5	3.25
11/4/2010	12/3/2010	12/5/2010	12/10/2010	1825	1	0	0	114708	1805	102128	28	3.5	0.5
11/11/2010	12/10/2010	12/12/2010	12/17/2010	(238)	4	1513	-1513	114470	(318)	101810	29	2.5	3
11/18/2010	12/17/2010	12/19/2010	12/24/2010	(863)	1	-863	-863	113607	(883)	100927	30	2.5	2.75
11/25/2010	12/24/2010	12/26/2010	12/31/2010	750	4	1600	-1900	114357	670	101597	13	3.5	2.75
12/2/2010	12/31/2010	1/2/2011	1/7/2011	8750	1	0	0	123107	8730	110327	23	3.5	1.75
12/9/2010	1/7/2011	1/9/2011	1/14/2011	4288	1	0	0	127395	4268	114595	26	3	3.5
12/16/2010	1/14/2011	1/16/2011	1/21/2011	3263	3	-213	-213	130658	3203	117798	24	1.75	2.75
12/23/2010	1/21/2011	1/23/2011	1/28/2011	(563)	2	-638	-638	130095	(603)	117195	22	2.75	3.25
12/30/2010	1/28/2011	1/30/2011	2/4/2011	1050	1	0	0	131145	1030	118225	26	2.5	3
1/6/2011	2/4/2011	2/6/2011	2/11/2011	(350)	1	-350	-350	130795	(370)	117855	17	0.25	3.25
1/13/2011	2/11/2011	2/13/2011	2/18/2011	675	8	-500	-1188	131470	515	118370	11	1.75	2.5
1/20/2011	2/18/2011	2/20/2011	2/25/2011	(488)	4	-875	-875	130982	(568)	117802	23	1.75	2.25
1/27/2011	2/25/2011	2/27/2011	3/4/2011	2025	1	0	0	133007	2005	119807	13	2.5	3.25

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
2/3/2011	3/4/2011	3/6/2011	3/11/2011	(1300)	1	1300	-1300	131707	(1320)	118487	21	2.25	3
2/10/2011	3/11/2011	3/13/2011	3/18/2011	3250	4	-288	-488	134957	3170	121657	26	0.25	3
2/17/2011	3/18/2011	3/20/2011	3/25/2011	(1450)	2	1363	-1450	133507	(1490)	120167	12	3.25	3.5
2/24/2011	3/25/2011	3/27/2011	4/1/2011	1838	1	0	0	135345	1818	121985	24	2.75	3.5
3/3/2011	4/1/2011	4/3/2011	4/8/2011	2938	1	0	0	138283	2918	124903	16	2	3.5
3/10/2011	4/8/2011	4/10/2011	4/15/2011	(1888)	3	-913	-1888	136395	(1948)	122955	17	2.5	3.5
3/17/2011	4/15/2011	4/17/2011	4/22/2011	(875)	1	-875	-875	135520	(895)	122060	30	2	2
3/24/2011	4/22/2011	4/24/2011	4/29/2011	3225	1	0	0	138745	3205	125265	29	0.5	3.5
3/31/2011	4/29/2011	5/1/2011	5/6/2011	(1163)	11	1475	-5850	137582	(1383)	123882	8	3	3.25
4/7/2011	5/6/2011	5/8/2011	5/13/2011	(1813)	5	1650	-2488	135769	(1913)	121969	19	3.25	3
4/14/2011	5/13/2011	5/15/2011	5/20/2011	150	1	0	0	135919	130	122099	28	3.5	1.5
4/21/2011	5/20/2011	5/22/2011	5/27/2011	(2713)	5	1375	-2713	133206	(2813)	119286	30	3.25	0.5
4/28/2011	5/27/2011	5/29/2011	6/3/2011	2013	1	0	0	135219	1993	121279	30	3.25	2.75
5/5/2011	6/3/2011	6/5/2011	6/10/2011	(675)	4	1363	-1900	134544	(755)	120524	8	1.75	3.25
5/12/2011	6/10/2011	6/12/2011	6/17/2011	213	3	2213	-2213	134757	153	120677	30	1	2.75
5/19/2011	6/17/2011	6/19/2011	6/24/2011	(475)	2	-763	-763	134282	(515)	120162	30	1.5	3.5
5/26/2011	6/24/2011	6/26/2011	7/1/2011	663	4	1263	-1263	134945	583	120745	17	3	2.75
6/2/2011	7/1/2011	7/3/2011	7/8/2011	1163	5	-763	-1150	136108	1063	121808	15	3.25	2.25
6/9/2011	7/8/2011	7/10/2011	7/15/2011	975	8	1100	-1713	137083	815	122623	17	1.75	3.5
6/16/2011	7/15/2011	7/17/2011	7/22/2011	(3300)	8	1188	-4663	133783	(3460)	119163	7	3.25	3.25
6/23/2011	7/22/2011	7/24/2011	7/29/2011	(1125)	3	1338	-1488	132658	(1185)	117978	30	2.75	3.5
6/30/2011	7/29/2011	7/31/2011	8/5/2011	(2363)	5	1988	-3675	130295	(2463)	115515	29	1.25	3.5
7/7/2011	8/5/2011	8/7/2011	8/12/2011	925	11	-900	-2950	131220	705	116220	10	3.5	2
7/14/2011	8/12/2011	8/14/2011	8/19/2011	(675)	7	1500	-1638	130545	(815)	115405	9	3.25	2.5
7/21/2011	8/19/2011	8/21/2011	8/26/2011	(75)	3	-638	-975	130470	(135)	115270	13	3.5	2.75
7/28/2011	8/26/2011	8/28/2011	9/2/2011	2575	1	0	0	133045	2555	117825	27	2.5	3.25
8/4/2011	9/2/2011	9/4/2011	9/9/2011	1650	6	1063	-1625	134695	1530	119355	12	2.5	3
8/11/2011	9/9/2011	9/11/2011	9/16/2011	(5213)	5	3288	-5588	129482	(5313)	114042	17	3.25	2.5
8/18/2011	9/16/2011	9/18/2011	9/23/2011	1863	3	-313	-313	131345	1803	115845	19	3.5	1.25
8/25/2011	9/23/2011	9/25/2011	9/30/2011	(2025)	3	1388	-2613	129320	(2085)	113760	27	3.25	3.25
9/1/2011	9/30/2011	10/2/2011	10/7/2011	(925)	5	1113	-1425	128395	(1025)	112735	23	3	3.5
9/8/2011	10/7/2011	10/9/2011	10/14/2011	4525	5	-363	-363	132920	4425	117160	9	2.25	3.5
9/15/2011	10/14/2011	10/16/2011	10/21/2011	1600	6	-763	-1163	134520	1480	118640	9	3.5	3.5
9/22/2011	10/21/2011	10/23/2011	10/28/2011	2763	3	1238	-1238	137283	2703	121343	18	0.5	3.5
9/29/2011	10/28/2011	10/30/2011	11/4/2011	(4425)	14	2075	-5938	132858	(4705)	116638	21	1	3.25
10/6/2011	11/4/2011	11/6/2011	11/11/2011	(613)	5	1838	-1838	132245	(713)	115925	30	2	3.5
10/13/2011	11/11/2011	11/13/2011	11/18/2011	(1275)	5	1188	-2963	130970	(1375)	114550	17	3.5	3
10/20/2011	11/18/2011	11/20/2011	11/25/2011	3013	1	0	0	133983	2993	117543	17	3.5	3
10/27/2011	11/25/2011	11/27/2011	12/2/2011	(1363)	6	1575	-2750	132620	(1483)	116060	14	3.5	1.5
11/3/2011	12/2/2011	12/4/2011	12/9/2011	150	3	-75	-113	132770	90	116150	14	3.5	0.25
11/10/2011	12/9/2011	12/11/2011	12/16/2011	3313	1	0	0	136083	3293	119443	14	3.5	1.25
11/17/2011	12/16/2011	12/18/2011	12/23/2011	700	1	0	0	136783	680	120123	19	3.25	3.25

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
11/24/2011	12/23/2011	12/25/2011	12/30/2011	750	1	0	0	137533	730	120853	10	3.5	1.25
12/1/2011	12/30/2011	1/1/2012	1/6/2012	3588	2	-275	-275	141121	3548	124401	28	2.5	1
12/8/2011	1/6/2012	1/8/2012	1/13/2012	(638)	5	1438	-2113	140483	(738)	123663	20	2.5	0.5
12/15/2011	1/13/2012	1/15/2012	1/20/2012	75	3	1188	-1188	140558	15	123678	27	3	2.25
12/22/2011	1/20/2012	1/22/2012	1/27/2012	(1875)	14	-963	-2225	138683	(2155)	121523	8	3.5	0.75
12/29/2011	1/27/2012	1/29/2012	2/3/2012	(2388)	3	1100	-2388	136295	(2448)	119075	14	3.25	2.75
1/5/2012	2/3/2012	2/5/2012	2/10/2012	1350	1	0	0	137645	1330	120405	30	1	3.5
1/12/2012	2/10/2012	2/12/2012	2/17/2012	(1750)	3	1950	-2250	135895	(1810)	118595	21	2.25	3.5
1/19/2012	2/17/2012	2/19/2012	2/24/2012	0	0	0	0	135895	0	118595	24	3.5	3
1/26/2012	2/24/2012	2/26/2012	3/2/2012	6088	1	0	0	141983	6068	124663	23	3.5	0.25
2/2/2012	3/2/2012	3/4/2012	3/9/2012	338	1	0	0	142321	318	124981	17	3.25	3
2/9/2012	3/9/2012	3/11/2012	3/16/2012	538	1	0	0	142859	518	125499	18	2.75	3
2/16/2012	3/16/2012	3/18/2012	3/23/2012	(1725)	2	1038	-1725	141134	(1765)	123734	22	3.5	2.25
2/23/2012	3/23/2012	3/25/2012	3/30/2012	(275)	3	-538	-538	140859	(335)	123399	13	3	0.75
3/1/2012	3/30/2012	4/1/2012	4/6/2012	(2288)	3	1575	-2288	138571	(2348)	121051	11	0.75	3.5
3/8/2012	4/6/2012	4/8/2012	4/13/2012	(275)	1	-275	-275	138296	(295)	120756	17	1.5	3
3/15/2012	4/13/2012	4/15/2012	4/20/2012	0	0	0	0	138296	0	120756	18	3.5	3
3/22/2012	4/20/2012	4/22/2012	4/27/2012	(888)	1	-888	-888	137408	(908)	119848	16	3.25	3
3/29/2012	4/27/2012	4/29/2012	5/4/2012	1663	1	0	0	139071	1643	121491	26	2.75	2.5
4/5/2012	5/4/2012	5/6/2012	5/11/2012	(1325)	2	1113	-1325	137746	(1365)	120126	27	0.5	3.5
4/12/2012	5/11/2012	5/13/2012	5/18/2012	88	1	0	0	137834	68	120194	20	2.75	2.75
4/19/2012	5/18/2012	5/20/2012	5/25/2012	3100	1	0	0	140934	3080	123274	21	2.5	0.25
4/26/2012	5/25/2012	5/27/2012	6/1/2012	1913	6	-363	-988	142847	1793	125067	8	2.75	1.25
5/3/2012	6/1/2012	6/3/2012	6/8/2012	1263	4	-163	-163	144110	1183	126250	18	2.75	1.75
5/10/2012	6/8/2012	6/10/2012	6/15/2012	463	5	-775	-1063	144573	363	126613	30	3	0.25
5/17/2012	6/15/2012	6/17/2012	6/22/2012	(88)	10	-363	-1050	144485	(288)	126325	7	3	2
5/24/2012	6/22/2012	6/24/2012	6/29/2012	325	4	-900	-900	144810	245	126570	7	3	2.25
5/31/2012	6/29/2012	7/1/2012	7/6/2012	2913	1	0	0	147723	2893	129463	7	3.5	2.25
6/7/2012	7/6/2012	7/8/2012	7/13/2012	213	1	0	0	147936	193	129656	30	3.25	0.25
6/14/2012	7/13/2012	7/15/2012	7/20/2012	(675)	3	-638	-1175	147261	(735)	128921	21	3.25	1.75
6/21/2012	7/20/2012	7/22/2012	7/27/2012	338	2	-250	-250	147599	298	129219	24	3.25	2.75
6/28/2012	7/27/2012	7/29/2012	8/3/2012	(3613)	4	1650	-4375	143986	(3693)	125526	11	3.25	3.25
7/5/2012	8/3/2012	8/5/2012	8/10/2012	(1638)	1	1638	-1638	142348	(1658)	123868	29	1.75	2.25
7/12/2012	8/10/2012	8/12/2012	8/17/2012	(825)	2	-475	-825	141523	(865)	123003	29	1.5	2.5
7/19/2012	8/17/2012	8/19/2012	8/24/2012	2200	1	0	0	143723	2180	125183	30	0.5	3
7/26/2012	8/24/2012	8/26/2012	8/31/2012	(113)	7	-400	-400	143610	(253)	124930	7	2.25	1.75
8/2/2012	8/31/2012	9/2/2012	9/7/2012	2963	1	0	0	146573	2943	127873	22	0.25	3.5
8/9/2012	9/7/2012	9/9/2012	9/14/2012	2100	1	0	0	148673	2080	129953	26	3	2.5
8/16/2012	9/14/2012	9/16/2012	9/21/2012	(925)	2	-700	-925	147748	(965)	128988	26	3	2
8/23/2012	9/21/2012	9/23/2012	9/28/2012	525	1	0	0	148273	505	129493	26	3	2.25
8/30/2012	9/28/2012	9/30/2012	10/5/2012	1350	1	0	0	149623	1330	130823	9	3.25	3.5
9/6/2012	10/5/2012	10/7/2012	10/12/2012	(450)	1	-450	-450	149173	(470)	130353	12	3.5	3.25
9/13/2012	10/12/2012	10/14/2012	10/19/2012	(1425)	1	1425	-1425	147748	(1445)	128908	27	3.25	1
9/20/2012	10/19/2012	10/21/2012	10/26/2012	(1388)	1	1388	-1388	146360	(1408)	127500	28	1.25	3.25
9/27/2012	10/26/2012	10/28/2012	11/2/2012	(1113)	1	1113	-1113	145247	(1133)	126367	16	1.75	3.5
10/4/2012	11/2/2012	11/4/2012	11/9/2012	1113	3	-538	-763	146360	1053	127420	17	2.5	0.5
10/11/2012	11/9/2012	11/11/2012	11/16/2012	(513)	1	-513	-513	145847	(533)	126887	20	2.75	1.5
10/18/2012	11/16/2012	11/18/2012	11/23/2012	(2700)	1	2700	-2700	143147	(2720)	124167	26	2.25	0.5
10/25/2012	11/23/2012	11/25/2012	11/30/2012	(888)	4	-838	-1063	142259	(968)	123199	11	2.5	1.25

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
11/1/2012	11/30/2012	12/2/2012	12/7/2012	(175)	1	-175	-175	142084	(195)	123004	12	2.25	3.5
11/8/2012	12/7/2012	12/9/2012	12/14/2012	3150	1	0	0	145234	3130	126134	30	0.25	3.5
11/15/2012	12/14/2012	12/16/2012	12/21/2012	413	4	-550	-888	145647	333	126467	14	1.75	1.75
11/22/2012	12/21/2012	12/23/2012	12/28/2012	(13)	2	-213	-213	145634	(53)	126414	7	3	3.5
11/29/2012	12/28/2012	12/30/2012	1/4/2013	(1888)	1	1888	-1888	143746	(1908)	124506	22	1	3.25
12/6/2012	1/4/2013	1/6/2013	1/11/2013	3588	1	0	0	147334	3568	128074	26	0.5	3.25
12/13/2012	1/11/2013	1/13/2013	1/18/2013	(350)	1	-350	-350	146984	(370)	127704	26	2.5	3
12/20/2012	1/18/2013	1/20/2013	1/25/2013	1238	1	0	0	148222	1218	128922	29	2.5	2.75
12/27/2012	1/25/2013	1/27/2013	2/1/2013	(75)	3	1113	-1563	148147	(135)	128787	23	1	3.25
1/3/2013	2/1/2013	2/3/2013	2/8/2013	(1063)	3	1363	-1363	147084	(1123)	127664	25	0.5	3.25
1/10/2013	2/8/2013	2/10/2013	2/15/2013	(1038)	3	-925	-1238	146046	(1098)	126566	30	1	2.25
1/17/2013	2/15/2013	2/17/2013	2/22/2013	1263	1	0	0	147309	1243	127809	6	3	3
1/24/2013	2/22/2013	2/24/2013	3/1/2013	2813	1	0	0	150122	2793	130602	25	3.5	1.25
1/31/2013	3/1/2013	3/3/2013	3/8/2013	(1963)	2	1588	-1963	148159	(2003)	128599	27	3.25	2
2/7/2013	3/8/2013	3/10/2013	3/15/2013	(588)	1	-588	-588	147571	(608)	127991	12	3	2
2/14/2013	3/15/2013	3/17/2013	3/22/2013	(963)	1	-963	-963	146608	(983)	127008	16	3.25	3.25
2/21/2013	3/22/2013	3/24/2013	3/29/2013	588	5	-963	-1738	147196	488	127496	30	0.75	1.75
2/28/2013	3/29/2013	3/31/2013	4/5/2013	1763	5	-425	-975	148959	1663	129159	6	1	3.25
3/7/2013	4/5/2013	4/7/2013	4/12/2013	0	0	0	0	148959	0	129159	29	3.5	2.75
3/14/2013	4/12/2013	4/14/2013	4/19/2013	1063	1	0	0	150022	1043	130202	30	3.5	1.75
3/21/2013	4/19/2013	4/21/2013	4/26/2013	(563)	1	-563	-563	149459	(583)	129619	23	2	2.5
3/28/2013	4/26/2013	4/28/2013	5/3/2013	1363	5	-688	-1200	150822	1263	130882	6	1.5	3.5
4/4/2013	5/3/2013	5/5/2013	5/10/2013	(1475)	5	1013	-1950	149347	(1575)	129307	11	0.75	3
4/11/2013	5/10/2013	5/12/2013	5/17/2013	1500	1	0	0	150847	1480	130787	22	3	1
4/18/2013	5/17/2013	5/19/2013	5/24/2013	(1000)	2	-650	-1000	149847	(1040)	129747	28	2.5	1.25
4/25/2013	5/24/2013	5/26/2013	5/31/2013	(2288)	5	-963	-2288	147559	(2388)	127359	26	3	1
5/2/2013	5/31/2013	6/2/2013	6/7/2013	(50)	9	1100	-2138	147509	(230)	127129	6	2.25	2.25
5/9/2013	6/7/2013	6/9/2013	6/14/2013	675	1	0	0	148184	655	127784	26	2	3
5/16/2013	6/14/2013	6/16/2013	6/21/2013	2325	1	0	0	150509	2305	130089	18	3	3.25
5/23/2013	6/21/2013	6/23/2013	6/28/2013	(1150)	3	1150	-1150	149359	(1210)	128879	30	0.5	2.5
5/30/2013	6/28/2013	6/30/2013	7/5/2013	(275)	2	1250	-1250	149084	(315)	128564	7	3.25	3.5
6/6/2013	7/5/2013	7/7/2013	7/12/2013	1913	3	1038	-1038	150997	1853	130417	11	3.5	2.25
6/13/2013	7/12/2013	7/14/2013	7/19/2013	(1138)	1	1138	-1138	149859	(1158)	129259	17	2.75	1
6/20/2013	7/19/2013	7/21/2013	7/26/2013	(863)	1	-863	-863	148996	(883)	128376	17	2.75	1.5
6/27/2013	7/26/2013	7/28/2013	8/2/2013	(50)	1	-50	-50	148946	(70)	128306	18	1.5	3.5
7/4/2013	8/2/2013	8/4/2013	8/9/2013	600	1	0	0	149546	580	128886	20	1	3
7/11/2013	8/9/2013	8/11/2013	8/16/2013	375	1	0	0	149921	355	129241	30	1.5	3.5
7/18/2013	8/16/2013	8/18/2013	8/23/2013	(113)	3	-650	-775	149808	(173)	129068	9	0.75	2
7/25/2013	8/23/2013	8/25/2013	8/30/2013	2000	3	-75	-88	151808	1940	131008	26	1.75	0.25
8/1/2013	8/30/2013	9/1/2013	9/6/2013	(75)	1	-75	-75	151733	(95)	130913	6	3.5	3.5
8/8/2013	9/6/2013	9/8/2013	9/13/2013	(1600)	1	1600	-1600	150133	(1620)	129293	17	3.25	0.5
8/15/2013	9/13/2013	9/15/2013	9/20/2013	1838	1	0	0	151971	1818	131111	16	3.25	3
8/22/2013	9/20/2013	9/22/2013	9/27/2013	0	0	0	0	151971	0	131111	29	2.75	2.5
8/29/2013	9/27/2013	9/29/2013	10/4/2013	688	1	0	0	152659	668	131779	28	0.25	3.5
9/5/2013	10/4/2013	10/6/2013	10/11/2013	0	0	0	0	152659	0	131779	29	2.5	2.5
9/12/2013	10/11/2013	10/13/2013	10/18/2013	(763)	2	1513	-1513	151896	(803)	130976	20	2.25	2.5
9/19/2013	10/18/2013	10/20/2013	10/25/2013	663	5	-288	-388	152559	563	131539	6	0.5	2.25
9/26/2013	10/25/2013	10/27/2013	11/1/2013	3050	2	-400	-400	155609	3010	134549	25	1.75	1.75
10/3/2013	11/1/2013	11/3/2013	11/8/2013	(800)	1	-800	-800	154809	(820)	133729	24	3	2.75
10/10/2013	11/8/2013	11/10/2013	11/15/2013	(313)	2	-788	-788	154496	(353)	133376	24	2.25	2

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
10/17/2013	11/15/2013	11/17/2013	11/22/2013	(1163)	1	1163	-1163	153333	(1183)	132193	22	3.25	1
10/24/2013	11/22/2013	11/24/2013	11/29/2013	(450)	1	-450	-450	152883	(470)	131723	9	3.25	0.25
10/31/2013	11/29/2013	12/1/2013	12/6/2013	1000	3	-688	-888	153883	940	132663	18	0.5	3
11/7/2013	12/6/2013	12/8/2013	12/13/2013	0	0	0	0	153883	0	132663	28	1.5	3
11/14/2013	12/13/2013	12/15/2013	12/20/2013	563	2	-163	-163	154446	523	133186	10	2	2.5
11/21/2013	12/20/2013	12/22/2013	12/27/2013	(638)	1	-638	-638	153808	(658)	132528	11	2.25	2.5
11/28/2013	12/27/2013	12/29/2013	1/3/2014	1350	1	0	0	155158	1330	133858	6	2.75	3.5
12/5/2013	1/3/2014	1/5/2014	1/10/2014	(800)	1	-800	-800	154358	(820)	133038	27	3.25	1
12/12/2013	1/10/2014	1/12/2014	1/17/2014	1300	1	0	0	155658	1280	134318	29	2.5	1.25
12/19/2013	1/17/2014	1/19/2014	1/24/2014	(1113)	5	1075	-1300	154545	(1213)	133105	19	2.75	0.75
12/26/2013	1/24/2014	1/26/2014	1/31/2014	1863	3	-325	-325	156408	1803	134908	21	2.5	0.75
1/2/2014	1/31/2014	2/2/2014	2/7/2014	325	1	0	0	156733	305	135213	17	3	2
1/9/2014	2/7/2014	2/9/2014	2/14/2014	(188)	2	-475	-475	156545	(228)	134985	18	3	2
1/16/2014	2/14/2014	2/16/2014	2/21/2014	(313)	1	-313	-313	156232	(333)	134652	6	3.25	2.5
1/23/2014	2/21/2014	2/23/2014	2/28/2014	675	1	0	0	156907	655	135307	30	0.25	3.5
1/30/2014	2/28/2014	3/2/2014	3/7/2014	713	3	-250	-250	157620	653	135960	11	0.25	3
2/6/2014	3/7/2014	3/9/2014	3/14/2014	(1063)	2	-950	-1063	156557	(1103)	134857	9	2.5	3
2/13/2014	3/14/2014	3/16/2014	3/21/2014	450	3	-600	-600	157007	390	135247	14	1	3
2/20/2014	3/21/2014	3/23/2014	3/28/2014	(1400)	6	-888	-1875	155607	(1520)	133727	25	0.75	1
2/27/2014	3/28/2014	3/30/2014	4/4/2014	338	1	0	0	155945	318	134045	11	3.5	1.5
3/6/2014	4/4/2014	4/6/2014	4/11/2014	(175)	1	-175	-175	155770	(195)	133850	27	3.5	1
3/13/2014	4/11/2014	4/13/2014	4/18/2014	463	1	0	0	156233	443	134293	14	3.5	1
3/20/2014	4/18/2014	4/20/2014	4/25/2014	250	1	0	0	156483	230	134523	11	0.25	2.5
3/27/2014	4/25/2014	4/27/2014	5/2/2014	63	1	0	0	156546	43	134566	26	0.5	3
4/3/2014	5/2/2014	5/4/2014	5/9/2014	1038	3	-413	-413	157584	978	135544	18	0.5	3
4/10/2014	5/9/2014	5/11/2014	5/16/2014	900	1	0	0	158484	880	136424	14	3	0.5
4/17/2014	5/16/2014	5/18/2014	5/23/2014	0	0	0	0	158484	0	136424	13	2.5	2.25
4/24/2014	5/23/2014	5/25/2014	5/30/2014	0	0	0	0	158484	0	136424	13	2.5	2.25
5/1/2014	5/30/2014	6/1/2014	6/6/2014	(363)	2	-638	-638	158121	(403)	136021	6	3.25	2.25
5/8/2014	6/6/2014	6/8/2014	6/13/2014	(25)	1	-25	-25	158096	(45)	135976	6	3.25	2.25
5/15/2014	6/13/2014	6/15/2014	6/20/2014	0	0	0	0	158096	0	135976	18	1.75	3.5
5/22/2014	6/20/2014	6/22/2014	6/27/2014	0	0	0	0	158096	0	135976	16	1.75	3.5
5/29/2014	6/27/2014	6/29/2014	7/4/2014	713	1	0	0	158809	693	136669	6	3	1.5
6/5/2014	7/4/2014	7/6/2014	7/11/2014	0	0	0	0	158809	0	136669	9	2	3.25
6/12/2014	7/11/2014	7/13/2014	7/18/2014	(963)	1	-963	-963	157846	(983)	135686	17	0.25	3
6/19/2014	7/18/2014	7/20/2014	7/25/2014	1375	1	0	0	159221	1355	137041	24	2	0.25
6/26/2014	7/25/2014	7/27/2014	8/1/2014	(700)	1	-700	-700	158521	(720)	136321	12	2	1.25
7/3/2014	8/1/2014	8/3/2014	8/8/2014	(238)	1	-238	-238	158283	(258)	136063	29	1.75	1
7/10/2014	8/8/2014	8/10/2014	8/15/2014	(1300)	3	-863	-1300	156983	(1360)	134703	17	1.75	0.75
7/17/2014	8/15/2014	8/17/2014	8/22/2014	(200)	1	-200	-200	156783	(220)	134483	11	0.75	2.5
7/24/2014	8/22/2014	8/24/2014	8/29/2014	(913)	2	-850	-913	155870	(953)	133530	7	1	2
7/31/2014	8/29/2014	8/31/2014	9/5/2014	950	1	0	0	156820	930	134460	15	3.25	1.25
8/7/2014	9/5/2014	9/7/2014	9/12/2014	(813)	1	-813	-813	156007	(833)	133627	20	2	2
8/14/2014	9/12/2014	9/14/2014	9/19/2014	(413)	2	1138	-1138	155594	(453)	133174	27	1.75	1.75
8/21/2014	9/19/2014	9/21/2014	9/26/2014	2175	1	0	0	157769	2155	135329	16	2.75	1.75
8/28/2014	9/26/2014	9/28/2014	10/3/2014	(450)	5	-800	-1888	157319	(550)	134779	16	1.75	1.75
9/4/2014	10/3/2014	10/5/2014	10/10/2014	(1613)	3	2400	-2713	155706	(1673)	133106	18	2.25	1
9/11/2014	10/10/2014	10/12/2014	10/17/2014	675	5	1088	-1125	156381	575	133681	6	3.5	1.5
9/18/2014	10/17/2014	10/19/2014	10/24/2014	1238	1	0	0	157619	1218	134899	15	2	2.5
9/25/2014	10/24/2014	10/26/2014	10/31/2014	663	3	-738	-738	158282	603	135502	20	1.25	2.5
10/2/2014	10/31/2014	11/2/2014	11/7/2014	(2475)	2	1925	-2475	155807	(2515)	132987	11	3	3
10/9/2014	11/7/2014	11/9/2014	11/14/2014	(900)	1	-900	-900	154907	(920)	132067	28	3.5	0.75
10/16/2014	11/14/2014	11/16/2014	11/21/2014	1350	1	0	0	156257	1330	133397	29	3	1.25
10/23/2014	11/21/2014	11/23/2014	11/28/2014	(625)	3	1163	-1163	155632	(685)	132712	10	3.25	1
10/30/2014	11/28/2014	11/30/2014	12/5/2014	275	3	-675	-850	155907	215	132927	14	2.25	2.5

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
11/6/2014	12/5/2014	12/7/2014	12/12/2014	0	0	0	0	155907	0	132927	13	3.5	3
11/13/2014	12/12/2014	12/14/2014	12/19/2014	2600	1	0	0	158507	2580	135507	30	3.5	0.75
11/20/2014	12/19/2014	12/21/2014	12/26/2014	588	1	0	0	159095	568	136075	21	2.5	1
11/27/2014	12/26/2014	12/28/2014	1/2/2015	2088	1	0	0	161183	2068	138143	30	3.5	0.25
12/4/2014	1/2/2015	1/4/2015	1/9/2015	1525	1	0	0	162708	1505	139648	29	3.25	1.75
12/11/2014	1/9/2015	1/11/2015	1/16/2015	2525	3	-550	-550	165233	2465	142113	24	2.25	0.25
12/18/2014	1/16/2015	1/18/2015	1/23/2015	4613	3	-363	-363	169846	4553	146666	18	2	2.5
12/25/2014	1/23/2015	1/25/2015	1/30/2015	(4263)	5	2488	-4850	165583	(4363)	142303	29	3	2
1/1/2015	1/30/2015	2/1/2015	2/6/2015	(2825)	4	1400	-3525	162758	(2905)	139398	24	2	2.25
1/8/2015	2/6/2015	2/8/2015	2/13/2015	(1488)	1	1488	-1488	161270	(1508)	137890	11	3.5	2.5
1/15/2015	2/13/2015	2/15/2015	2/20/2015	200	4	-88	-88	161470	120	138010	12	3.5	2.25
1/22/2015	2/20/2015	2/22/2015	2/27/2015	1088	2	-375	-375	162558	1048	139058	10	2	2.5
1/29/2015	2/27/2015	3/1/2015	3/6/2015	3563	1	0	0	166121	3543	142601	9	2	2.75
2/5/2015	3/6/2015	3/8/2015	3/13/2015	900	3	1200	-1200	167021	840	143441	28	1.75	2.5
2/12/2015	3/13/2015	3/15/2015	3/20/2015	4150	6	-750	-1488	171171	4030	147471	27	1.75	1.75
2/19/2015	3/20/2015	3/22/2015	3/27/2015	1175	5	-600	-1150	172346	1075	148546	23	1.75	2.75
2/26/2015	3/27/2015	3/29/2015	4/3/2015	1425	1	0	0	173771	1405	149951	16	2.5	3.25
3/5/2015	4/3/2015	4/5/2015	4/10/2015	475	3	2200	-2200	174246	415	150366	28	1.5	3.25
3/12/2015	4/10/2015	4/12/2015	4/17/2015	2800	1	0	0	177046	2780	153146	26	1.75	3.5
3/19/2015	4/17/2015	4/19/2015	4/24/2015	1450	1	0	0	178496	1430	154576	26	3	3.5
3/26/2015	4/24/2015	4/26/2015	5/1/2015	2575	3	-538	-538	181071	2515	157091	21	1.75	3.5
4/2/2015	5/1/2015	5/3/2015	5/8/2015	513	1	0	0	181584	493	157584	13	1.75	3.5
4/9/2015	5/8/2015	5/10/2015	5/15/2015	3388	1	0	0	184972	3368	160952	21	1.25	3.25
4/16/2015	5/15/2015	5/17/2015	5/22/2015	1138	5	-913	-1200	186110	1038	161990	24	1.25	2
4/23/2015	5/22/2015	5/24/2015	5/29/2015	1538	1	0	0	187648	1518	163508	10	1.75	3.25
4/30/2015	5/29/2015	5/31/2015	6/5/2015	3188	3	1500	-1500	190836	3128	166636	17	3.25	2.75
5/7/2015	6/5/2015	6/7/2015	6/12/2015	(1588)	2	1425	-1588	189248	(1628)	165008	29	3	2.5
5/14/2015	6/12/2015	6/14/2015	6/19/2015	(763)	2	-925	-925	188485	(803)	164205	25	3.25	2
5/21/2015	6/19/2015	6/21/2015	6/26/2015	(3263)	2	2625	-3263	185222	(3303)	160902	16	1.25	3.5
5/28/2015	6/26/2015	6/28/2015	7/3/2015	325	2	-300	-300	185547	285	161187	22	1.75	3.25
6/4/2015	7/3/2015	7/5/2015	7/10/2015	(2738)	5	1863	-2738	182809	(2838)	158349	24	2.25	1.5
6/11/2015	7/10/2015	7/12/2015	7/17/2015	3750	1	0	0	186559	3730	162079	28	3	0.5
6/18/2015	7/17/2015	7/19/2015	7/24/2015	600	1	0	0	187159	580	162659	23	2.5	3.5
6/25/2015	7/24/2015	7/26/2015	7/31/2015	(1450)	1	1450	-1450	185709	(1470)	161189	30	2.75	3.25
7/2/2015	7/31/2015	8/2/2015	8/7/2015	0	0	0	0	185709	0	161189	30	3.5	3.5
7/9/2015	8/7/2015	8/9/2015	8/14/2015	0	0	0	0	185709	0	161189	29	3.5	3.5
7/16/2015	8/14/2015	8/16/2015	8/21/2015	3550	1	0	0	189259	3530	164719	24	0.75	3.5
7/23/2015	8/21/2015	8/23/2015	8/28/2015	(1213)	14	2138	-2513	188046	(1493)	163226	7	3.5	2.5
7/30/2015	8/28/2015	8/30/2015	9/4/2015	38	3	-775	-775	188084	(22)	163204	30	0.25	3.25
8/6/2015	9/4/2015	9/6/2015	9/11/2015	888	1	0	0	188972	868	164072	13	3.5	3.5
8/13/2015	9/11/2015	9/13/2015	9/18/2015	(1438)	2	1300	-1438	187534	(1478)	162594	23	3.25	2.25
8/20/2015	9/18/2015	9/20/2015	9/25/2015	1125	1	0	0	188659	1105	163699	23	2.5	1.25
8/27/2015	9/25/2015	9/27/2015	10/2/2015	(25)	1	-25	-25	188634	(45)	163654	29	2.25	3
9/3/2015	10/2/2015	10/4/2015	10/9/2015	1325	4	-375	-375	189959	1245	164899	23	1.5	1.75
9/10/2015	10/9/2015	10/11/2015	10/16/2015	1038	1	0	0	190997	1018	165917	21	2.25	1.75
9/17/2015	10/16/2015	10/18/2015	10/23/2015	(1188)	6	1625	-2350	189809	(1308)	164609	24	0.5	2
9/24/2015	10/23/2015	10/25/2015	10/30/2015	(1125)	1	1125	-1125	188684	(1145)	163464	18	3.25	3.25
10/1/2015	10/30/2015	11/1/2015	11/6/2015	(1663)	2	1713	-1713	187021	(1703)	161761	8	3.25	3.25

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
10/8/2015	11/6/2015	11/8/2015	11/13/2015	(350)	1	-350	-350	186671	(370)	161391	18	3.25	2
10/15/2015	11/13/2015	11/15/2015	11/20/2015	288	3	-313	-413	186959	228	161619	6	3	1.75
10/22/2015	11/20/2015	11/22/2015	11/27/2015	13	1	0	0	186972	(7)	161612	30	1.75	1.25
10/29/2015	11/27/2015	11/29/2015	12/4/2015	2525	3	-850	-850	189497	2465	164077	22	2.5	1.5
11/5/2015	12/4/2015	12/6/2015	12/11/2015	(63)	1	-63	-63	189434	(83)	163994	13	2.5	3.5
11/12/2015	12/11/2015	12/13/2015	12/18/2015	(150)	3	1275	-1275	189284	(210)	163784	19	2	3.25
11/19/2015	12/18/2015	12/20/2015	12/25/2015	638	1	0	0	189922	618	164402	30	0.5	3.25
11/26/2015	12/25/2015	12/27/2015	1/1/2016	1188	1	0	0	191110	1168	165570	22	3.25	0.75
12/3/2015	1/1/2016	1/3/2016	1/8/2016	(988)	3	1025	-1125	190122	(1048)	164522	23	3	1
12/10/2015	1/8/2016	1/10/2016	1/15/2016	(363)	1	-363	-363	189759	(383)	164139	20	3.25	1.5
12/17/2015	1/15/2016	1/17/2016	1/22/2016	544	2	-556	-556	190303	504	164643	18	1.75	2
12/24/2015	1/22/2016	1/24/2016	1/29/2016	(563)	2	-831	-831	189740	(603)	164040	19	1.75	2
12/31/2015	1/29/2016	1/31/2016	2/5/2016	(1831)	3	1644	-1831	187909	(1891)	162149	18	3.25	1.25
1/7/2016	2/5/2016	2/7/2016	2/12/2016	1225	5	-238	-238	189134	1125	163274	8	0.75	3.5
1/14/2016	2/12/2016	2/14/2016	2/19/2016	(925)	1	-925	-925	188209	(945)	162329	20	0.75	3.5
1/21/2016	2/19/2016	2/21/2016	2/26/2016	(2269)	1	2269	-2269	185940	(2289)	160040	25	0.25	3
1/28/2016	2/26/2016	2/28/2016	3/4/2016	344	1	0	0	186284	324	160364	29	1.5	3.5
2/4/2016	3/4/2016	3/6/2016	3/11/2016	4206	3	0	0	190490	4146	164510	13	3.5	0.25
2/11/2016	3/11/2016	3/13/2016	3/18/2016	(500)	6	1563	-1563	189990	(620)	163890	6	3.5	0.25
2/18/2016	3/18/2016	3/20/2016	3/25/2016	0	0	0	0	189990	0	163890	18	3.5	3.25
2/25/2016	3/25/2016	3/27/2016	4/1/2016	2763	1	0	0	192753	2743	166633	8	1.75	3.5
3/3/2016	4/1/2016	4/3/2016	4/8/2016	0	0	0	0	192753	0	166633	20	3.25	3.5
3/10/2016	4/8/2016	4/10/2016	4/15/2016	(1944)	1	1944	-1944	190809	(1964)	164669	20	1.25	3.5
3/17/2016	4/15/2016	4/17/2016	4/22/2016	(775)	4	-863	-863	190034	(855)	163814	14	0.25	2.75
3/24/2016	4/22/2016	4/24/2016	4/29/2016	0	0	0	0	190034	0	163814	14	3	2.75
3/31/2016	4/29/2016	5/1/2016	5/6/2016	900	1	0	0	190934	880	164694	12	3.5	1
4/7/2016	5/6/2016	5/8/2016	5/13/2016	1044	1	0	0	191978	1024	165718	11	3	1
4/14/2016	5/13/2016	5/15/2016	5/20/2016	69	1	0	0	192047	49	165767	9	2	3
4/21/2016	5/20/2016	5/22/2016	5/27/2016	813	1	0	0	192860	793	166560	22	2.5	1.75
4/28/2016	5/27/2016	5/29/2016	6/3/2016	(1013)	2	1944	-1944	191847	(1053)	165507	21	2	0.75
5/5/2016	6/3/2016	6/5/2016	6/10/2016	1269	1	0	0	193116	1249	166756	27	2.5	0.25
5/12/2016	6/10/2016	6/12/2016	6/17/2016	219	3	-944	-944	193335	159	166915	20	1.5	2.5
5/19/2016	6/17/2016	6/19/2016	6/24/2016	2419	5	-500	-500	195754	2319	169234	23	1.25	3.5
5/26/2016	6/24/2016	6/26/2016	7/1/2016	(988)	1	-988	-988	194766	(1008)	168226	21	3.25	2
6/2/2016	7/1/2016	7/3/2016	7/8/2016	200	3	-256	-313	194966	140	168366	16	3	1
6/9/2016	7/8/2016	7/10/2016	7/15/2016	(313)	1	-313	-313	194653	(333)	168033	23	0.5	3.5
6/16/2016	7/15/2016	7/17/2016	7/22/2016	0	0	0	0	194653	0	168033	27	2.5	3
6/23/2016	7/22/2016	7/24/2016	7/29/2016	1531	1	0	0	196184	1511	169544	28	3	2.5
6/30/2016	7/29/2016	7/31/2016	8/5/2016	(188)	1	-188	-188	195996	(208)	169336	23	2.5	2
7/7/2016	8/5/2016	8/7/2016	8/12/2016	0	0	0	0	195996	0	169336	29	2.25	3.5
7/14/2016	8/12/2016	8/14/2016	8/19/2016	(800)	1	-800	-800	195196	(820)	168516	17	2.75	1.75
7/21/2016	8/19/2016	8/21/2016	8/26/2016	1063	1	0	0	196259	1043	169559	14	2	2.75
7/28/2016	8/26/2016	8/28/2016	9/2/2016	(188)	1	-188	-188	196071	(208)	169351	14	3.5	1
8/4/2016	9/2/2016	9/4/2016	9/9/2016	313	1	0	0	196384	293	169644	8	1.25	3.5
8/11/2016	9/9/2016	9/11/2016	9/16/2016	0	0	0	0	196384	0	169644	12	2.5	3.25
8/18/2016	9/16/2016	9/18/2016	9/23/2016	(475)	1	-475	-475	195909	(495)	169149	29	2.75	0.75
8/25/2016	9/23/2016	9/25/2016	9/30/2016	(663)	7	-669	-1181	195246	(803)	168346	13	1	1.5
9/1/2016	9/30/2016	10/2/2016	10/7/2016	231	1	0	0	195477	211	168557	29	3.25	0.75
9/8/2016	10/7/2016	10/9/2016	10/14/2016	2719	1	0	0	198196	2699	171256	25	2.25	0.5
9/15/2016	10/14/2016	10/16/2016	10/21/2016	1225	1	0	0	199421	1205	172461	15	1.5	0.5
9/22/2016	10/21/2016	10/23/2016	10/28/2016	(1525)	1	1525	-1525	197896	(1545)	170916	19	3	1
9/29/2016	10/28/2016	10/30/2016	11/4/2016	(2125)	1	2125	-2125	195771	(2145)	168771	30	2.5	0.5
10/6/2016	11/4/2016	11/6/2016	11/11/2016	6156	7	-431	-431	201927	6016	174787	14	2.25	1.5

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
10/13/2016	11/11/2016	11/13/2016	11/18/2016	(3981)	11	1894	-3981	197946	(4201)	170586	21	0.5	2
10/20/2016	11/18/2016	11/20/2016	11/25/2016	0	0	0	0	197946	0	170586	9	2.75	3.5
10/27/2016	11/25/2016	11/27/2016	12/2/2016	(94)	1	-94	-94	197852	(114)	170472	25	3.25	0.25
11/3/2016	12/2/2016	12/4/2016	12/9/2016	(263)	7	1050	-2331	197589	(403)	170069	7	3.25	0.25
11/10/2016	12/9/2016	12/11/2016	12/16/2016	(813)	5	1563	-1825	196776	(913)	169156	16	1	3.5
11/17/2016	12/16/2016	12/18/2016	12/23/2016	0	0	0	0	196776	0	169156	12	2.5	3.25
11/24/2016	12/23/2016	12/25/2016	12/30/2016	(688)	1	-688	-688	196088	(708)	168448	18	3	2.75
12/1/2016	12/30/2016	1/1/2017	1/6/2017	1863	2	0	0	197951	1823	170271	16	3.25	2.75
12/8/2016	1/6/2017	1/8/2017	1/13/2017	356	1	0	0	198307	336	170607	21	3.5	3.25
12/15/2016	1/13/2017	1/15/2017	1/20/2017	(288)	3	-975	-1256	198019	(348)	170259	19	1	2.5
12/22/2016	1/20/2017	1/22/2017	1/27/2017	0	0	0	0	198019	0	170259	27	2.75	2.75
12/29/2016	1/27/2017	1/29/2017	2/3/2017	(1944)	1	1944	-1944	196075	(1964)	168295	27	2.75	2.75
1/5/2017	2/3/2017	2/5/2017	2/10/2017	(2088)	1	2088	-2088	193987	(2108)	166187	30	0.25	2
1/12/2017	2/10/2017	2/12/2017	2/17/2017	113	1	0	0	194100	93	166280	7	3.5	0.5
1/19/2017	2/17/2017	2/19/2017	2/24/2017	763	1	0	0	194863	743	167023	19	3.5	0.25
1/26/2017	2/24/2017	2/26/2017	3/3/2017	344	1	0	0	195207	324	167347	14	2	3
2/2/2017	3/3/2017	3/5/2017	3/10/2017	(1388)	4	1113	-1394	193819	(1468)	165879	13	3.25	0.5
2/9/2017	3/10/2017	3/12/2017	3/17/2017	719	5	-600	-613	194538	619	166498	27	2	0.75
2/16/2017	3/17/2017	3/19/2017	3/24/2017	625	1	0	0	195163	605	167103	15	0.75	3.5
2/23/2017	3/24/2017	3/26/2017	3/31/2017	(2656)	3	1400	-2656	192507	(2716)	164387	12	0.75	2.5
3/2/2017	3/31/2017	4/2/2017	4/7/2017	669	1	0	0	193176	649	165036	21	3.5	1.5
3/9/2017	4/7/2017	4/9/2017	4/14/2017	(369)	1	-369	-369	192807	(389)	164647	27	3.25	0.75
3/16/2017	4/14/2017	4/16/2017	4/21/2017	(1444)	1	1444	-1444	191363	(1464)	163183	15	3.5	1.25
3/23/2017	4/21/2017	4/23/2017	4/28/2017	(1056)	2	-606	-1056	190307	(1096)	162087	23	3.25	0.75
3/30/2017	4/28/2017	4/30/2017	5/5/2017	1244	1	0	0	191551	1224	163311	21	0.25	2.5
4/6/2017	5/5/2017	5/7/2017	5/12/2017	(569)	1	-569	-569	190982	(589)	162722	15	0.5	2.5
4/13/2017	5/12/2017	5/14/2017	5/19/2017	4313	3	-88	-88	195295	4253	166975	22	0.25	2
4/20/2017	5/19/2017	5/21/2017	5/26/2017	(275)	2	-425	-425	195020	(315)	166660	30	1.25	1.75
4/27/2017	5/26/2017	5/28/2017	6/2/2017	1838	1	0	0	196858	1818	168478	11	1.5	3
5/4/2017	6/2/2017	6/4/2017	6/9/2017	(1119)	13	-675	-1413	195739	(1379)	167099	8	0.5	1.5
5/11/2017	6/9/2017	6/11/2017	6/16/2017	(375)	1	-375	-375	195364	(395)	166704	30	0.5	3
5/18/2017	6/16/2017	6/18/2017	6/23/2017	0	0	0	0	195364	0	166704	7	1.5	1.75
5/25/2017	6/23/2017	6/25/2017	6/30/2017	1781	3	-400	-400	197145	1721	168425	6	1.75	2.25
6/1/2017	6/30/2017	7/2/2017	7/7/2017	(669)	1	-669	-669	196476	(689)	167736	8	2.5	1.75
6/8/2017	7/7/2017	7/9/2017	7/14/2017	(106)	1	-106	-106	196370	(126)	167610	25	1.5	3.25
6/15/2017	7/14/2017	7/16/2017	7/21/2017	1344	1	0	0	197714	1324	168934	14	3.25	3.25
6/22/2017	7/21/2017	7/23/2017	7/28/2017	725	1	0	0	198439	705	169639	16	3.5	2.5
6/29/2017	7/28/2017	7/30/2017	8/4/2017	269	2	0	0	198708	229	169868	6	3	3.25
7/6/2017	8/4/2017	8/6/2017	8/11/2017	563	2	-200	-200	199271	523	170391	22	1.25	2.25
7/13/2017	8/11/2017	8/13/2017	8/18/2017	0	0	0	0	199271	0	170391	17	2.75	2.75
7/20/2017	8/18/2017	8/20/2017	8/25/2017	2019	1	0	0	201290	1999	172390	24	0.5	1.75
7/27/2017	8/25/2017	8/27/2017	9/1/2017	(1419)	2	1350	-1419	199871	(1459)	170931	21	1.5	1.75
8/3/2017	9/1/2017	9/3/2017	9/8/2017	663	3	-369	-369	200534	603	171534	14	1.5	3.25
8/10/2017	9/8/2017	9/10/2017	9/15/2017	(900)	1	-900	-900	199634	(920)	170614	10	0.75	3.5
8/17/2017	9/15/2017	9/17/2017	9/22/2017	0	3	-788	-788	199634	(60)	170554	11	0.75	3.5
8/24/2017	9/22/2017	9/24/2017	9/29/2017	1413	1	0	0	201047	1393	171947	12	2	1.5
8/31/2017	9/29/2017	10/1/2017	10/6/2017	(350)	1	-350	-350	200697	(370)	171577	6	2.5	3.25
9/7/2017	10/6/2017	10/8/2017	10/13/2017	(450)	3	-700	-875	200247	(510)	171067	8	3.5	1
9/14/2017	10/13/2017	10/15/2017	10/20/2017	(1306)	3	-588	-1306	198941	(1366)	169701	6	1.5	2.75
9/21/2017	10/20/2017	10/22/2017	10/27/2017	1675	1	0	0	200616	1655	171356	24	2.75	1
9/28/2017	10/27/2017	10/29/2017	11/3/2017	119	1	0	0	200735	99	171455	13	2.25	1.75
10/5/2017	11/3/2017	11/5/2017	11/10/2017	0	0	0	0	200735	0	171455	10	2.25	3.5
10/12/2017	11/10/2017	11/12/2017	11/17/2017	0	0	0	0	200735	0	171455	8	3	2.75

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
10/19/2017	11/17/2017	11/19/2017	11/24/2017	1263	2	-450	-450	201998	1223	172678	11	1.75	2
10/26/2017	11/24/2017	11/26/2017	12/1/2017	(519)	1	-519	-519	201479	(539)	172139	18	0.5	3
11/2/2017	12/1/2017	12/3/2017	12/8/2017	0	0	0	0	201479	0	172139	28	1.75	2
11/9/2017	12/8/2017	12/10/2017	12/15/2017	1106	1	0	0	202585	1086	173225	10	0.25	2.75
11/16/2017	12/15/2017	12/17/2017	12/22/2017	0	0	0	0	202585	0	173225	9	3	2.25
11/23/2017	12/22/2017	12/24/2017	12/29/2017	0	0	0	0	202585	0	173225	9	3	2.25
11/30/2017	12/29/2017	12/31/2017	1/5/2018	81	1	0	0	202666	61	173286	14	3.25	1.75
12/7/2017	1/5/2018	1/7/2018	1/12/2018	1894	1	0	0	204560	1874	175160	11	0.5	2.25
12/14/2017	1/12/2018	1/14/2018	1/19/2018	375	1	0	0	204935	355	175515	23	2.25	1.5
12/21/2017	1/19/2018	1/21/2018	1/26/2018	0	3	-831	-831	204935	(60)	175455	15	2.25	3
12/28/2017	1/26/2018	1/28/2018	2/2/2018	(675)	1	-675	-675	204260	(695)	174760	29	3.5	1
1/4/2018	2/2/2018	2/4/2018	2/9/2018	(1575)	10	1581	-1738	202685	(1775)	172985	7	0.5	2.5
1/11/2018	2/9/2018	2/11/2018	2/16/2018	2988	3	-6	-6	205673	2928	175913	6	0.25	3.5
1/18/2018	2/16/2018	2/18/2018	2/23/2018	(38)	1	-38	-38	205635	(58)	175855	22	3	2
1/25/2018	2/23/2018	2/25/2018	3/2/2018	(950)	1	-950	-950	204685	(970)	174885	16	3.5	2
2/1/2018	3/2/2018	3/4/2018	3/9/2018	1144	1	0	0	205829	1124	176009	22	3.25	0.25
2/8/2018	3/9/2018	3/11/2018	3/16/2018	(1138)	1	1138	-1138	204691	(1158)	174851	18	1.75	3.5
2/15/2018	3/16/2018	3/18/2018	3/23/2018	469	1	0	0	205160	449	175300	16	1.75	2.5
2/22/2018	3/23/2018	3/25/2018	3/30/2018	(888)	1	-888	-888	204272	(908)	174392	6	0.5	3.5
3/1/2018	3/30/2018	4/1/2018	4/6/2018	(669)	3	-531	-713	203603	(729)	173663	9	0.75	2.75
3/8/2018	4/6/2018	4/8/2018	4/13/2018	281	1	0	0	203884	261	173924	11	2.75	1.5
3/15/2018	4/13/2018	4/15/2018	4/20/2018	225	2	-394	-394	204109	185	174109	26	1.25	1.75
3/22/2018	4/20/2018	4/22/2018	4/27/2018	1556	1	0	0	205665	1536	175645	28	3.25	0.5
3/29/2018	4/27/2018	4/29/2018	5/4/2018	1700	5	-125	-125	207365	1600	177245	7	2.75	0.5
4/5/2018	5/4/2018	5/6/2018	5/11/2018	(663)	3	-394	-663	206702	(723)	176522	12	2.25	1.25
4/12/2018	5/11/2018	5/13/2018	5/18/2018	2431	1	0	0	209133	2411	178933	29	1.5	0.25
4/19/2018	5/18/2018	5/20/2018	5/25/2018	(431)	2	1306	-1306	208702	(471)	178462	15	3.25	2.25
4/26/2018	5/25/2018	5/27/2018	6/1/2018	2175	2	0	0	210877	2135	180597	8	3	2.75
5/3/2018	6/1/2018	6/3/2018	6/8/2018	575	1	0	0	211452	555	181152	7	3.5	3.25
5/10/2018	6/8/2018	6/10/2018	6/15/2018	1806	1	0	0	213258	1786	182938	18	3	1.25
5/17/2018	6/15/2018	6/17/2018	6/22/2018	738	1	0	0	213996	718	183656	8	3	3.25
5/24/2018	6/22/2018	6/24/2018	6/29/2018	481	1	0	0	214477	461	184117	10	3.5	3
5/31/2018	6/29/2018	7/1/2018	7/6/2018	0	0	0	0	214477	0	184117	17	3.25	2.5
6/7/2018	7/6/2018	7/8/2018	7/13/2018	850	1	0	0	215327	830	184947	19	3.25	1
6/14/2018	7/13/2018	7/15/2018	7/20/2018	600	1	0	0	215927	580	185527	13	2.25	3.5
6/21/2018	7/20/2018	7/22/2018	7/27/2018	(969)	1	-969	-969	214958	(989)	184538	11	0.5	3
6/28/2018	7/27/2018	7/29/2018	8/3/2018	0	0	0	0	214958	0	184538	7	2	3.25
7/5/2018	8/3/2018	8/5/2018	8/10/2018	1663	1	0	0	216621	1643	186181	26	2.75	1
7/12/2018	8/10/2018	8/12/2018	8/17/2018	500	1	0	0	217121	480	186661	8	1.75	2.25
7/19/2018	8/17/2018	8/19/2018	8/24/2018	(1850)	4	-813	-1850	215271	(1930)	184731	13	2	1.25
7/26/2018	8/24/2018	8/26/2018	8/31/2018	906	3	-281	-281	216177	846	185577	11	2	1.5
8/2/2018	8/31/2018	9/2/2018	9/7/2018	313	2	0	0	216490	273	185850	20	1	2.25
8/9/2018	9/7/2018	9/9/2018	9/14/2018	725	1	0	0	217215	705	186555	19	1	3.25
8/16/2018	9/14/2018	9/16/2018	9/21/2018	(1506)	2	1313	-1506	215709	(1546)	185009	27	2	1.5
8/23/2018	9/21/2018	9/23/2018	9/28/2018	125	5	1000	-1000	215834	25	185034	20	1	1.25
8/30/2018	9/28/2018	9/30/2018	10/5/2018	(1144)	5	-713	-1419	214690	(1244)	183790	10	1.25	2.5
9/6/2018	10/5/2018	10/7/2018	10/12/2018	0	0	0	0	214690	0	183790	24	3	2.5
9/13/2018	10/12/2018	10/14/2018	10/19/2018	925	1	0	0	215615	905	184695	25	3	1.5
9/20/2018	10/19/2018	10/21/2018	10/26/2018	1538	1	0	0	217153	1518	186213	25	2.75	1.5
9/27/2018	10/26/2018	10/28/2018	11/2/2018	(106)	1	-106	-106	217047	(126)	186087	12	3.5	2.5
10/4/2018	11/2/2018	11/4/2018	11/9/2018	844	1	0	0	217891	824	186911	19	2.25	1.25
10/11/2018	11/9/2018	11/11/2018	11/16/2018	(806)	6	-506	-1306	217085	(926)	185985	10	2.5	1
10/18/2018	11/16/2018	11/18/2018	11/23/2018	219	3	-525	-525	217304	159	186144	12	2.5	2.75
10/25/2018	11/23/2018	11/25/2018	11/30/2018	325	3	-550	-550	217629	265	186409	9	1.75	1.75
11/1/2018	11/30/2018	12/2/2018	12/7/2018	0	0	0	0	217629	0	186409	10	3	2.5
11/8/2018	12/7/2018	12/9/2018	12/14/2018	913	1	0	0	218542	893	187302	14	2.25	2.5

in-Sample Dates		Out-Of-Sample Dates		osp	ont	ollt	odd	EQ	osnp\$20	NetEq	N	vup	vdn
11/15/2018	12/14/2018	12/16/2018	12/21/2018	(1200)	3	1194	-1944	217342	(1260)	186042	8	3	2.5
11/22/2018	12/21/2018	12/23/2018	12/28/2018	(419)	1	-419	-419	216923	(439)	185603	15	3	1
11/29/2018	12/28/2018	12/30/2018	1/4/2019	856	1	0	0	217779	836	186439	24	3.25	0.75
12/6/2018	1/4/2019	1/6/2019	1/11/2019	(419)	3	-900	-1113	217360	(479)	185960	24	2.75	0.75
12/13/2018	1/11/2019	1/13/2019	1/18/2019	(1363)	1	1363	-1363	215997	(1383)	184577	26	0.25	2.75
12/20/2018	1/18/2019	1/20/2019	1/25/2019	250	1	0	0	216247	230	184807	8	1.5	3
12/27/2018	1/25/2019	1/27/2019	2/1/2019	(944)	3	1044	-1225	215303	(1004)	183803	24	3.25	0.5
1/3/2019	2/1/2019	2/3/2019	2/8/2019	1700	1	0	0	217003	1680	185483	26	3.5	0.25
1/10/2019	2/8/2019	2/10/2019	2/15/2019	(50)	1	-50	-50	216953	(70)	185413	9	2	2.5
1/17/2019	2/15/2019	2/17/2019	2/22/2019	281	1	0	0	217234	261	185674	29	0.5	2
1/24/2019	2/22/2019	2/24/2019	3/1/2019	(175)	1	-175	-175	217059	(195)	185479	15	3.5	0.25
1/31/2019	3/1/2019	3/3/2019	3/8/2019	1369	1	0	0	218428	1349	186828	24	1.75	1
2/7/2019	3/8/2019	3/10/2019	3/15/2019	0	0	0	0	218428	0	186828	21	2	1.25
2/14/2019	3/15/2019	3/17/2019	3/22/2019	688	2	-531	-531	219116	648	187476	21	2	1.25
2/21/2019	3/22/2019	3/24/2019	3/29/2019	1094	1	0	0	220210	1074	188550	10	3	1
2/28/2019	3/29/2019	3/31/2019	4/5/2019	(325)	2	-256	-325	219885	(365)	188185	7	1.5	1.5
3/7/2019	4/5/2019	4/7/2019	4/12/2019	(400)	1	-400	-400	219485	(420)	187765	16	2.5	0.5
3/14/2019	4/12/2019	4/14/2019	4/19/2019	769	1	0	0	220254	749	188514	16	2	0.75
3/21/2019	4/19/2019	4/21/2019	4/26/2019	1156	1	0	0	221410	1136	189650	30	3.5	1.5

Appendix: The Normalization Multiplier

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=26.6399
14 Std=0.0346289 1/std=28.8776
16 Std=0.0322738 1/std=30.9849
18 Std=0.0302399 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 v_{up} and v_{dn} 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 N s for The RMedV are proportional to \sqrt{N} . So, if we multiply the RMedV by the \sqrt{N} , the RMedV for different N should have the same SDs and ranges. Below are the results for multiplying the RMedV by \sqrt{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=0.126638 1/std=7.89652
30 Std=0.12607 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 $7.669 \cdot \sqrt{N}$ 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.