

Trading 1Min Bar Euro Futures Using The Fading Memory Polynomial Velocity Strategy

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This is a mathematical technique that fits a n^{th} order polynomial to the last T price bars but calculates the coefficients of the polynomial such that the error between the current n^{th} order polynomial and the current bar is weighted much higher than the error between the price T bars ago and the value of the n^{th} order polynomial T bars ago. As an example, if the latest price is at time t and the price made a turn at time bar $t-10$, then we do not want prices prior to $t-10$ affecting the current polynomial fit as much. As will be shown the most familiar case of this fading memory technique is the exponential moving average. The fading memory technique contrasts with the Least Squares Polynomial fit, which weights all past errors between the polynomial and the price bar equally.

In previous working papers at <http://www.meyersanalytics.com/papers.php> we showed how the application of a price curve generated by Nth Order Fixed Memory Polynomial Velocity could be used to develop a strategy to buy and sell futures intraday. The reasoning behind this type of system was to only trade when the price trend velocity was above a certain threshold. Many times, prices meander around without any notable trend and this is considered noise. During these times we do not wish to trade because of the cost of whipsaw losses that would occur from this type of price action. When a price trend finally starts, the velocity of that price trend moves above a minimum threshold noise value. Thus, the velocity system would only issue a trade when certain velocity thresholds above "noise" levels are crossed.

The velocity system that we will use here to trade the Euro futures contract is called the Nth Order **Fading** Memory Adaptive Polynomial Velocity Strategy. The word "Adaptive" is used because the polynomial inputs change over time, adapting to the changing trading patterns of the Euro futures contract. The Nth Order Fading Memory Adaptive Polynomial Velocity Strategy has a number of unknown inputs that we have to determine before we can use this strategy to trade. These unknown inputs to the Fading Memory Polynomial are the polynomial order, the optimum number of prices we need to determine the coefficients of the polynomial and finally the velocity thresholds. Here we will use Walk Forward Optimization and out-of-sample performance to determine the "best" polynomial inputs as well as how these inputs should change over time. We will use the nth Order Fading Memory Adaptive Polynomial Velocity System to trade the Euro futures contract on an intraday basis using one-minute bar price data. To test this strategy, we will use one-minute bar prices of the Euro futures contract (EC) traded on the CME/Globex from January 3, 2008 to June 28, 2019.

The nth Order Fading Memory Adaptive Polynomial Velocity Defined

The adaptive nth order Fading Memory Polynomial Velocity is constructed and plotted at each bar by solving for the coefficients $b_1, b_2, b_3, \dots, b_n$ for the discrete orthogonal Meixner polynomials at each bar using the exponential decay factor $\alpha=(1-\beta)$ and the equation for b_j shown in the “Math” appendix of this paper. Then $\text{Velocity}(T+1)$ is constructed from the equation shown in the appendix and plotted under the price chart.

The velocity of a 2nd order polynomial should change faster than the straight line (1st order velocity). As observed from the 2nd order velocity equation in the appendix section, there is an acceleration component in the calculation of the velocity. This means that the 2nd order velocity will reflect a change in the price trend much faster than the straight-line velocity which does not have an acceleration component.

At each bar we calculate the 2nd order fading memory polynomial velocity from the formulas in the appendix. When the velocity is greater than the threshold amount vup we will go long. When the velocity is less than the threshold amount $-vdown$ we will go short.

Buy Rule:

IF Velocity is greater than the threshold amount vup then buy at the market.

Sell Rule:

IF Velocity is less than the threshold amount $-vdown$ then sell at the market.

The strategy follows the velocity curve. When the velocity is greater than the threshold amount vup a buy signal is issued. The threshold vup serves as a noise filter. That is, price noise creates a lot of small back and forth velocity movement. Unless the velocity can break some threshold to the upside, no trade is issued, and the move is considered price noise. The same logic holds for the sell threshold $vdown$.

Intraday Bars Exit Rule:

Close the position at 1350 when U.S trading dies down. (no trades will be carried overnight).

Note: Before July 2015 floor trading stopped at 1400 CST

Intraday Bars First Trade of Day Entry Rule:

Ignore all trade signals before 7:00am. For the Buy and Sell rules above we have included a first trade of the day entry rule. Trading in the EC futures has changed a lot in the last 7 years because of 24hr Globex trading. Trading starts a lot earlier in the morning when Asia and then Europe opens and then dies down. The EC volume starts to pick up again around 7am CST here in the U.S. so we will have the strategy resume trading at 7am.

Discussion of Euro Prices

The Euro (EC) is traded on Globex. On Globex the EC is traded on a 23hour basis. The Old CME hours for floor trading (RTH) are 7:20 to 14:00 CST. Approximately Over 50% of the

volume in the EC is done on Globex during the Old CME RTH hours. We have restricted our study to only trading the EC during 7:00 to 1350 hours.

Data Discussion

To test this strategy, we will use 1-minute bar prices of the Euro futures contract traded on the and known by the symbol *EC* for the 595 weeks from January 2, 2008 to June 28, 2019.

We will test this strategy with the above EC 1min bars on a walk forward basis, as will be described below. In TradeStation (TS) or MultiCharts (MC), we will run the FadmVn Strategy on the EC 1 min bar data from January 3, 2008 to June 28, 2019. We will breakup and create 30-day calendar *in-sample* sections along with their corresponding one calendar week *out-of-sample* sections from the 595 weeks of EC (see Walk forward Testing below) creating 595 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 FadmVn Strategy on the EC 1min data from 1/3/2008 to 6/28/2019. 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 595 weeks of EC (see Walk Forward Testing below) creating 595 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 Polynomial Velocity System Using Walk Forward Optimization

There will be three strategy parameters to determine:

degree degree=2 for 2nd order velocity.

alpha=(1-β) The exponential decay weight for the Nth Order Fading Memory Polynomial calculation.

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

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

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 *ōcurve* 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 on average. *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 *öluckö*. 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 *öluckö*, 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

For the in-sample data we will run the TradeStation optimization engine on the 595 weeks of EC 1 min bars with the following ranges for the nth order fading memory polynomial velocity strategy input variables.

1. **pw=degree =2**
2. **N from 20 to 70 in steps of 10.**
3. **vup from 0.25 to 3.5 steps of 0.25**
4. **vdn from 0.25 to 3.5 in steps of 0.25**
5. **Mult = 6200, iNorm=1 (See Appendix 3, the Normalization Multiplier)**

Note: I use N because it gives a better understanding of how many bars of past data are approximately being used.

N and α ($\alpha=1-\beta$) are approximately related by the formula $\alpha=2/(1+N)$. N is converted to α by this formula in the Nth Order Fading Memory Polynomial calculation

This will produce 1176 different cases or combinations of the input parameters for each of the 595 PWFO output files.

Finding the Strategy Input Parameters in The Walk Forward Test Sections

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 543 in-sample and out-of-sample sections. We will leave the 52 sections of EC data from 6/29/18 to 6/28/2019 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, we wish to limit the number losing trades in a row (**lr**) in the IS period to 5 or less (**lr**≤5). **r2** is defined as the in-sample trade equity regression trend line coefficient of correlation **r**². High **r2** values in the in-sample section usually mean poor performance in the out-of-sample-section. This is also a kind of reversion to the mean and a measure of how well the price noise is being fitted in the IS section. So, in the in-sample section we eliminate all strategy input rows that have a **r2**>50. Using the **pf-lr-r2** elimination screen, as described, there can still be 100s of rows left in the in-sample section. The PWFO generates the performance metric named **nT**. This metric is the number of trades in the in-sample section. Let us choose the 50 rows in the in-sample section that contain the **minimum number of in-sample trades. nT (with the criteria that nT≥3)**, values from the rows that are left from the **pf-lr-r2** screen. In other words, we sort **nT** from low to high, eliminate the rows that have **nT**<3, **pf**>2, **lr**>5, **r2**>50 and then choose the smallest **50 nT (nT≥3)** of whatever is left. This filter will now leave 50 cases or rows in the in-sample section that satisfy the above filter conditions. We call this filter **b50nT|p≤2|lr≤5|r2≤50** where **b50nT** means the bottom or minimum **50 nT with nT≥3** rows left *after* the **pf-lr-r2** in-sample row elimination. Suppose for this filter, within the 50 in-sample rows that are left, we want the row that has the lowest loss of the column metric called **dd**. **dd** is the drawdown in the in-sample section for a given set of inputs. We abbreviate this final filter as **b50nt|p≤2|lr≤5|r2≤50-dd**. 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 **b50nt|p≤2|lr≤5|r2≤50-dd filter** is then applied to each of the 543 *in-sample sections* between 2/8/2008 and 6/29/2018 (the 52 out-of-sample sections between 6/29/18-6/28/19 are withheld from the WFME in-sample filter run) which give 543 sets of strategy inputs that are used to produce the corresponding 543 out-of-sample performance results. The average out-of-sample performance is calculated from these 543 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 3** 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 500 random OSNP picks for each mirror filter will generate a random total out-of-sample net profit (**toNP**) or final random equity for each of the 5000 mirror filters. 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 5000-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 543 out-of-sample files of **(\$141.8)** with a bootstrap standard deviation of **\$48.9**. (Side Note. The average is the random average per out-of-sample period. So, the average for the random selection would be the random (Average Random toNP/543) and the average net weekly for the filter from **Figure 2, Row 3** would be the *filter toNP/ (# of OOS)* periods traded or $87891/400=219.73$. The probability of obtaining our filters average weekly net profit of **219.73** is 7.35×10^{-14} which is **7.39** standard deviations from the random bootstrap average. For our filter, in Row 3, the expected number of cases that we could obtain by pure chance that would match or exceed **\$219.73** is $[1-(1- 7.35 \times 10^{-14})^{172980}] \approx 172980 \times 7.35 \times 10^{-14} = 1.27 \times 10^{-8}$ where **172980** is the total number of different filters we looked at in the WFME64v8x run. This number is much less than one, so it is improbable that our filters result of 89891 was due to pure chance

Results

Table 1 on page 8 below presents a table of the 595 in-sample and out-of-sample windows, the selected optimum parameters and the weekly out-of-sample results using the filter described above.

Figure 1 presents a graph of the equity curve generated by using the WFME64 filter on the 543 weeks ending 2/8/2008 ó 6/29/18 and the equity curve on the 52 weeks following until 6/28/2019 (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 ES weekly closing prices superimposed on the Equity Chart. The vertical dotted red line on the right separates the WFME run excluded period equity from 6/29/18 to 6/28/19. This is what would have happened if you used the strategy inputs found by the filter **b50nt|p≤2|lr≤5|r2≤50-dd** on data not included in the initial WFME 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 3** of the sample output in **Figure 2** shows the results of the filter discussed above.

Figure 3 Walk Forward Out-Of-Sample Performance for EC Fading Memory Polynomial Velocity System

1 minute bar chart of EC from 12/4/15-12/4/2015

Discussion of Strategy Performance of the WFME64 run

In **Figure 2, Row 3** is the filter chosen, **b50nt|p≤2|lr≤5|r2≤50-dd**. This Metric Filter produced \$87891 net profits after costs in 543 weeks and \$4022 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 44 weeks for this filter. This means that 44 weeks was the longest time that the equity for this strategy failed to make a new equity high in the 543 out-of-sample weeks. For this strategy, the **%P** (% of weekly oos periods that are positive) was **62%**, and the **%Wtr** (The % of all oos trades that are positive) was **54%**. This low **%Wtr** was made up for by **oW/oL** (average oos winning trades/average oos losing trades) equal to 1.38.

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 10 to 70. 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.

Using this filter, the strategy generated a profit of \$91,913 net equity after commissions and slippage of \$20/trade trading one EC contract for the total 595 weeks. From **Table 1**, the largest losing week was -\$2313 on the week ending 4/3/09. The largest drawdown was -\$4989 from the week ending on 12/11/09 to 3/26/10. This drawdown lasted 15 weeks and took 8 weeks to recover and make a new equity high. The **future** 52-week period that was not included in the

WFME64 run from 6/29/18 to 6/28/19 was a volatile down market yet the FadmV strategy/WFME filter did well making a net profit of \$4072 during that one-year time frame.

Lastly, as can be seen in **Figure 3**, the top 10 filters all did very well in the 52 *future* weeks from 6/29/18 to 6/28/19 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 143 of the 543 weeks to a high of 15 trades/week with an average of 2.3 trades/week in the weeks it did trade.

Given 24-hour trading of the Euro, restricting the strategy to trade only from 7am to 1:50pm caused the strategy to miss many profitable trends opportunities when Asia and then Europe opened trading in the early morning. Further research will include the A.M. time zones.

References

1. Efron, B., Tibshirani, R.J., (1993), "An Introduction to the Bootstrap", New York, Chapman & Hall/CRC.
2. Morrison, Norman "Introduction to Sequential Smoothing and Prediction", McGraw-Hill Book Company, New York, 1969.

Figure 1 Graph of Net Equity Curve Applying the Walk Forward Filter Each Week on EC 1-min Bar Prices 01/04/08 – 06/28/19

Note: The blue line is the equity curve without commissions and the red dots on the blue line are new highs in equity. The brown line is the equity curve with commissions and the green dots are the new highs in net equity. The grey line is the EC Weekly Closing prices superimposed on the Equity Chart.

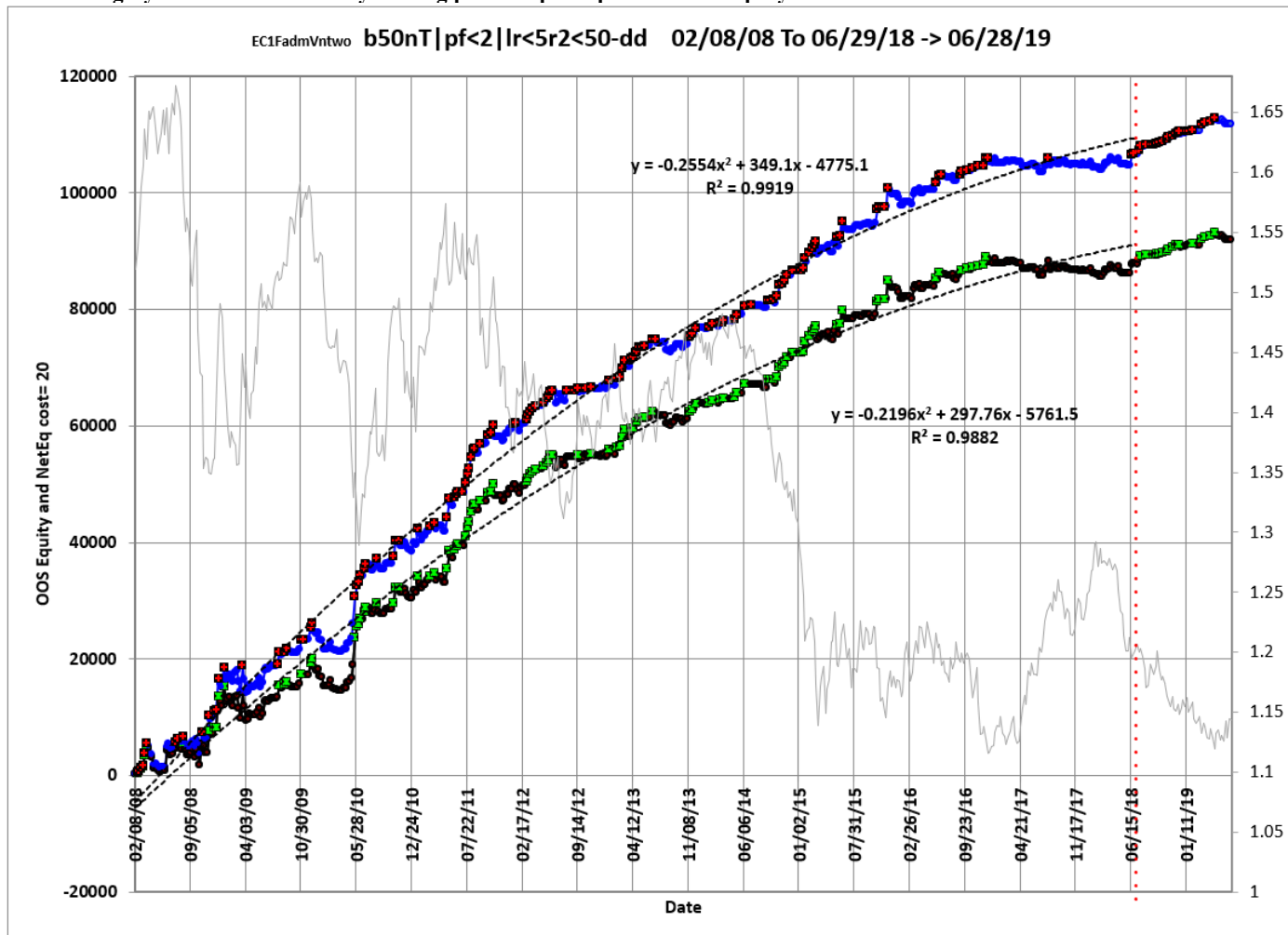


Figure 2_ Partial output of the Walk Forward Metric Performance Explorer (WFME)
EC 1-min bars The Nth Order Fading Memory Velocity System

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	EC1FadmVntwo	s02/08/08	e06/29/18	#543	AnyTnp	#52					ISnt3		
2	Filter-Metric	toGP	toNP	aoGP	aoTr	ao#T	std	skew	kur	t	oW oL	%Wtr	%P
3	b50nT pf<2 lr<5r2<50-dd	106651	87891	267	113.7	2.3	1002	1.104	7.03	5.32	1.38	54	62
4	b50nT pf<2 r2<50-dd	105388	86948	263	114.3	2.3	1022	0.921	7.02	5.16	1.37	54	62
5	t20ktau r2<50-nT	100658	79878	246	96.9	2.5	1024	0.987	6.84	4.86	1.32	53	59
6	t20eqR2 pf<3 r<5r2<60-nT	106249	79829	227	80.4	2.8	1008	0.894	7.02	4.87	1.32	52	58
7	t20ktau pf<4 r2<50-nT	101415	79555	240	92.8	2.6	1018	0.916	7.16	4.84	1.34	53	60
8	t10m(p-rd) pf<3 r<3r2<60-PF	108424	78304	229	72.0	3.2	998	0.778	6.34	4.99	1.35	51	58
9	b50nT pf<2 r2<40-dd	96059	77499	241	103.5	2.3	1010	0.822	6.56	4.76	1.34	53	59
10	t10ktau pf<4 r<5r2<50-nT	100861	77301	235	85.6	2.7	1028	0.672	6.49	4.73	1.31	52	60

	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
1	a(141.8)	s48.9	f172980					c=\$20							s07/06/18	e06/28/19	#52				t595
2	LlTr	LLp	eqDD	wpr	lpr	#	V20	Dev^2	KTau	eqR2	Blw	BE	tkr bl		toGPx	toNPx	aoTRx	aoNTx	#x	tOnpNet	Prob
3	-1775	-2313	-4989	12	4	400	19	6374	95	96	44	81	1382		5182	4022	89	1.6	36	91913	7.35E-14
4	-1775	-3550	-4989	12	4	400	19	5899	95	97	44	86	1262		5182	4022	89	1.6	36	90970	1.05E-13
5	-1675	-3050	-10928	9	11	409	14	5775	94	96	46	97	986		3119	1999	56	1.6	35	81877	2.78E-12
6	-1700	-3100	-8277	9	6	469	39	5074	95	97	44	96	1060		4231	2411	46	2.2	41	82240	8.98E-11
7	-1663	-3875	-9366	7	12	423	18	5695	94	96	46	97	976		3909	2569	58	1.7	39	82124	7.76E-12
8	-2225	-3200	-9262	8	5	474	47	6422	96	97	64	92	788		3795	1535	34	3	38	79839	1.75E-10
9	-2300	-3550	-4839	10	5	399	-2	6582	93	96	47	101	897		4489	3209	70	1.7	37	80708	3.24E-12
10	-2375	-4125	-11426	7	5	430	42	5492	93	97	72	102	579		6190	4770	87	1.9	38	82071	2.46E-11

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), **K**=Minimum number of trades in IS section, **N**= Bootstrap average, **O**= Bootstrap Standard Deviation, **P**=Number of filters run, **U**= Cost and slippage per trade, **AB**= Not Included in WFME Run PWFO File Start Date, **AC**= Not Included in WFME Run PWFO File End Date, **AD**=Number of PWFO Files not included in the WFME64 run (in this example weeks), **AH**= Number of Total PWFO Files.

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

Col A: *The Strategy Input/Filter Names Example* Row 3: **b50nT|p≤2||r≤5|r2≤50-dd:**

Col B: *toGP* - Total out-of-sample(oos) gross profit for these 543 oos periods (= weeks).

Col C: *toNP* - Total out-of-sample(oos) Net profit (toGP-Number of Trade Weeks*cost) for the 543 oos periods.

Col D: *aoGP* - Average oos gross profit for the 543 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 543 oos period profits and losses

Col H: *skew* - The Skew statistic of the 543 oos period profits and losses

Col I: *kur* - he kurtosis statistic of the 543 oos period profits and losses

Col J: *t* - The student t statistic for the 543 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: *v20* - The Velocity of a 2nd order polynomial fit to the last 20 periods of 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(#)*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 Walk Forward Out-Of-Sample Performance for EC Fading Memory Polynomial Velocity System
1 minute bar chart of EC from 4/28/19-4/26/119



Table 1 Walk Forward Out-Of-Sample Performance Summary for EC 1-min Nth Order Fading Memory Polynomial Velocity System

EC-1 min bars 1/3/2008 - 06/28/2019. The input values *degree(pw)*, *N*, *vup*, *vdn* are the values found from applying the filter to the in-sample section optimization runs.

Filter = : $b50nT|p \leq 2|lr \leq 5|r2 \leq 50$ -dd

- osnp = Weekly Out-of-sample gross profit in \$
- Equity = Running Sum of weekly out-of-sample gross profits \$
- NOnp\$20 = Weekly Out-Of-Sample Net Profit in \$ = osnp-ont*20.
- NetEq = running sum of the weekly out-of-sample net profits in \$
- ollt = The largest losing trade in the out-of-sample section in \$.
- odd = The drawdown in the out-of-sample section in \$.
- ont = The number of trades in the out-of-sample week.
- pw= degree, degree=1 for straight line velocity, degree=2 for 2nd order velocity, etc.
- 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			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
01/03/08	to	02/01/08	02/04/08	to	02/08/08	275	2	235	-525	-525	275	235	2	20	3	3.25
01/10/08	to	02/08/08	02/11/08	to	02/15/08	263	2	223	-13	-13	538	458	2	60	1.75	2.75
01/17/08	to	02/15/08	02/18/08	to	02/22/08	313	1	293	0	0	851	751	2	60	2.25	2.75
01/24/08	to	02/22/08	02/25/08	to	02/29/08	463	1	443	0	0	1314	1194	2	60	2.75	2
01/31/08	to	02/29/08	03/03/08	to	03/07/08	513	6	393	-425	-425	1827	1587	2	60	2	1.75
02/07/08	to	03/07/08	03/10/08	to	03/14/08	2000	2	1960	0	0	3827	3547	2	50	3	2.25
02/14/08	to	03/14/08	03/17/08	to	03/21/08	1788	3	1728	0	0	5615	5275	2	70	3	1.75
02/21/08	to	03/21/08	03/24/08	to	03/28/08	-575	1	-595	-575	-575	5040	4680	2	70	3.5	3.25
02/28/08	to	03/28/08	03/31/08	to	04/04/08	-1263	3	-1323	-1300	-2363	3777	3357	2	60	3.25	3.25
03/06/08	to	04/04/08	04/07/08	to	04/11/08	-113	2	-153	-375	-375	3664	3204	2	50	2.75	3
03/13/08	to	04/11/08	04/14/08	to	04/18/08	-1775	3	-1835	-913	-1775	1889	1369	2	50	3	3
03/20/08	to	04/18/08	04/21/08	to	04/25/08	88	1	68	0	0	1977	1437	2	70	2.75	3.5
03/27/08	to	04/25/08	04/28/08	to	05/02/08	-325	2	-365	-438	-438	1652	1072	2	40	3.5	3.5
04/03/08	to	05/02/08	05/05/08	to	05/09/08	-338	1	-358	-338	-338	1314	714	2	60	3	3.25
04/10/08	to	05/09/08	05/12/08	to	05/16/08	238	2	198	-188	-188	1552	912	2	40	3.5	3.5
04/17/08	to	05/16/08	05/19/08	to	05/23/08	0	0	0	0	0	1552	912	2	70	2.75	3.5
04/24/08	to	05/23/08	05/26/08	to	05/30/08	0	0	0	0	0	1552	912	2	70	3.25	3.5
05/01/08	to	05/30/08	06/02/08	to	06/06/08	3413	3	3353	0	0	4965	4265	2	70	2.75	3.25
05/08/08	to	06/06/08	06/09/08	to	06/13/08	575	6	455	-513	-575	5540	4720	2	30	3.25	1.75
05/15/08	to	06/13/08	06/16/08	to	06/20/08	-1088	5	-1188	-588	-1238	4452	3532	2	50	3.5	0.75
05/22/08	to	06/20/08	06/23/08	to	06/27/08	175	2	135	-375	-375	4627	3667	2	70	1.75	2.25
05/29/08	to	06/27/08	06/30/08	to	07/04/08	888	2	848	-613	-613	5515	4515	2	50	3	2.25
06/05/08	to	07/04/08	07/07/08	to	07/11/08	288	3	228	-50	-50	5803	4743	2	50	2.75	2.25
06/12/08	to	07/11/08	07/14/08	to	07/18/08	488	2	448	0	0	6291	5191	2	60	2.75	2.5
06/19/08	to	07/18/08	07/21/08	to	07/25/08	0	0	0	0	0	6291	5191	2	60	2.75	3
06/26/08	to	07/25/08	07/28/08	to	08/01/08	-638	2	-678	-1038	-1038	5653	4513	2	60	3	3.5
07/03/08	to	08/01/08	08/04/08	to	08/08/08	988	1	968	0	0	6641	5481	2	60	3.5	3
07/10/08	to	08/08/08	08/11/08	to	08/15/08	-950	3	-1010	-1125	-1125	5691	4471	2	60	3.5	3
07/17/08	to	08/15/08	08/18/08	to	08/22/08	-863	1	-883	-863	-863	4828	3588	2	60	3.5	3.5
07/24/08	to	08/22/08	08/25/08	to	08/29/08	0	0	0	0	0	4828	3588	2	40	3	3.25
07/31/08	to	08/29/08	09/01/08	to	09/05/08	425	3	365	-813	-813	5253	3953	2	50	3	3
08/07/08	to	09/05/08	09/08/08	to	09/12/08	575	3	515	-163	-163	5828	4468	2	50	3.5	3
08/14/08	to	09/12/08	09/15/08	to	09/19/08	-1013	9	-1193	-1213	-1825	4815	3275	2	60	3.25	3
08/21/08	to	09/19/08	09/22/08	to	09/26/08	1425	6	1305	-300	-300	6240	4580	2	50	3.5	2.75
08/28/08	to	09/26/08	09/29/08	to	10/03/08	-838	8	-998	-1200	-2250	5402	3582	2	60	3.5	3.5

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
09/04/08	to	10/03/08	10/06/08	to	10/10/08	-1575	6	-1695	-1375	-4125	3827	1887	2	60	3.5	3.5
09/11/08	to	10/10/08	10/13/08	to	10/17/08	3650	5	3550	-138	-138	7477	5437	2	70	3.25	2
09/18/08	to	10/17/08	10/20/08	to	10/24/08	-275	6	-395	-1175	-1975	7202	5042	2	70	3.25	2
09/25/08	to	10/24/08	10/27/08	to	10/31/08	-988	9	-1168	-1313	-2863	6214	3874	2	70	3.5	2.75
10/02/08	to	10/31/08	11/03/08	to	11/07/08	300	12	60	-950	-3850	6514	3934	2	40	3.25	2.75
10/09/08	to	11/07/08	11/10/08	to	11/14/08	3788	3	3728	0	0	10302	7662	2	70	3	3.5
10/16/08	to	11/14/08	11/17/08	to	11/21/08	-563	5	-663	-800	-1050	9739	6999	2	70	3	3.5
10/23/08	to	11/21/08	11/24/08	to	11/28/08	375	5	275	-350	-650	10114	7274	2	70	3.5	3.5
10/30/08	to	11/28/08	12/01/08	to	12/05/08	1025	3	965	-188	-188	11139	8239	2	70	3.25	2.25
11/06/08	to	12/05/08	12/08/08	to	12/12/08	138	3	78	-63	-63	11277	8317	2	60	3.25	3.5
11/13/08	to	12/12/08	12/15/08	to	12/19/08	5375	4	5295	0	0	16652	13612	2	70	3.5	3.5
11/20/08	to	12/19/08	12/22/08	to	12/26/08	-825	2	-865	-500	-825	15827	12747	2	70	2.75	2.5
11/27/08	to	12/26/08	12/29/08	to	01/02/09	-700	8	-860	-1438	-4063	15127	11887	2	70	3.5	2.75
12/04/08	to	01/02/09	01/05/09	to	01/09/09	3500	7	3360	-850	-1225	18627	15247	2	40	3	3.25
12/11/08	to	01/09/09	01/12/09	to	01/16/09	-2300	15	-2600	-1225	-3125	16327	12647	2	40	2	3
12/18/08	to	01/16/09	01/19/09	to	01/23/09	563	4	483	-763	-1413	16890	13130	2	70	3	2.5
12/25/08	to	01/23/09	01/26/09	to	01/30/09	463	8	303	-1350	-2075	17353	13433	2	70	3	2.25
01/01/09	to	01/30/09	02/02/09	to	02/06/09	-813	9	-993	-925	-2538	16540	12440	2	40	3	3
01/08/09	to	02/06/09	02/09/09	to	02/13/09	-388	7	-528	-863	-1363	16152	11912	2	40	3	3
01/15/09	to	02/13/09	02/16/09	to	02/20/09	1575	3	1515	0	0	17727	13427	2	70	3.25	2.25
01/22/09	to	02/20/09	02/23/09	to	02/27/09	313	4	233	-150	-150	18040	13660	2	70	3.25	2.75
01/29/09	to	02/27/09	03/02/09	to	03/06/09	-1900	4	-1980	-1075	-1913	16140	11680	2	70	3.25	2.75
02/05/09	to	03/06/09	03/09/09	to	03/13/09	-1763	3	-1823	-1775	-1950	14377	9857	2	70	3.5	3.5
02/12/09	to	03/13/09	03/16/09	to	03/20/09	4475	3	4415	0	0	18852	14272	2	60	3.5	3.5
02/19/09	to	03/20/09	03/23/09	to	03/27/09	-2238	6	-2358	-1300	-2375	16614	11914	2	60	2.25	3.5
02/26/09	to	03/27/09	03/30/09	to	04/03/09	-2313	4	-2393	-1038	-2313	14301	9521	2	50	3.5	2.75
03/05/09	to	04/03/09	04/06/09	to	04/10/09	150	2	110	-450	-450	14451	9631	2	70	3.5	3.25
03/12/09	to	04/10/09	04/13/09	to	04/17/09	1075	2	1035	-125	-125	15526	10666	2	70	2.5	3.25
03/19/09	to	04/17/09	04/20/09	to	04/24/09	-238	1	-258	-238	-238	15288	10408	2	70	3.5	3.25
03/26/09	to	04/24/09	04/27/09	to	05/01/09	0	2	-40	-413	-413	15288	10368	2	70	3.25	3.5
04/02/09	to	05/01/09	05/04/09	to	05/08/09	163	5	63	-1038	-2263	15451	10431	2	70	3.25	3.5
04/09/09	to	05/08/09	05/11/09	to	05/15/09	425	2	385	-388	-388	15876	10816	2	70	3.5	2.25
04/16/09	to	05/15/09	05/18/09	to	05/22/09	875	2	835	0	0	16751	11651	2	50	3.5	2.75
04/23/09	to	05/22/09	05/25/09	to	05/29/09	-1438	6	-1558	-738	-1875	15313	10093	2	50	2.5	3.25
04/30/09	to	05/29/09	06/01/09	to	06/05/09	675	3	615	-1063	-1063	15988	10708	2	60	3	3.25
05/07/09	to	06/05/09	06/08/09	to	06/12/09	2163	4	2083	-688	-688	18151	12791	2	60	3.25	2.25
05/14/09	to	06/12/09	06/15/09	to	06/19/09	263	5	163	-488	-488	18414	12954	2	70	3.25	2
05/21/09	to	06/19/09	06/22/09	to	06/26/09	-125	3	-185	-175	-175	18289	12769	2	50	3.25	3.5
05/28/09	to	06/26/09	06/29/09	to	07/03/09	438	1	418	0	0	18727	13187	2	50	3.25	3.5
06/04/09	to	07/03/09	07/06/09	to	07/10/09	50	1	30	0	0	18777	13217	2	50	3.25	3.5
06/11/09	to	07/10/09	07/13/09	to	07/17/09	0	0	0	0	0	18777	13217	2	50	3.5	3.25
06/18/09	to	07/17/09	07/20/09	to	07/24/09	0	0	0	0	0	18777	13217	2	40	3.5	3.5
06/25/09	to	07/24/09	07/27/09	to	07/31/09	288	2	248	0	0	19065	13465	2	70	2.75	2.75
07/02/09	to	07/31/09	08/03/09	to	08/07/09	2075	2	2035	0	0	21140	15500	2	60	3.5	2.75
07/09/09	to	08/07/09	08/10/09	to	08/14/09	-475	1	-495	-475	-475	20665	15005	2	60	3.5	3.5
07/16/09	to	08/14/09	08/17/09	to	08/21/09	250	1	230	0	0	20915	15235	2	60	3.25	3.5
07/23/09	to	08/21/09	08/24/09	to	08/28/09	400	1	380	0	0	21315	15615	2	60	3.25	3.5
07/30/09	to	08/28/09	08/31/09	to	09/04/09	538	2	498	-75	-75	21853	16113	2	60	3.5	3.5
08/06/09	to	09/04/09	09/07/09	to	09/11/09	-550	3	-610	-500	-788	21303	15503	2	40	2.75	3.5
08/13/09	to	09/11/09	09/14/09	to	09/18/09	0	0	0	0	0	21303	15503	2	60	3.25	3.5
08/20/09	to	09/18/09	09/21/09	to	09/25/09	-225	3	-285	-613	-613	21078	15218	2	60	2.75	3.5
08/27/09	to	09/25/09	09/28/09	to	10/02/09	25	1	5	0	0	21103	15223	2	70	3.25	3.5
09/03/09	to	10/02/09	10/05/09	to	10/09/09	0	0	0	0	0	21103	15223	2	70	2.5	3.5
09/10/09	to	10/09/09	10/12/09	to	10/16/09	0	0	0	0	0	21103	15223	2	50	3.5	3.5
09/17/09	to	10/16/09	10/19/09	to	10/23/09	638	1	618	0	0	21741	15841	2	70	2.75	3.25
09/24/09	to	10/23/09	10/26/09	to	10/30/09	1588	3	1528	-38	-38	23329	17369	2	60	2.25	3.25
10/01/09	to	10/30/09	11/02/09	to	11/06/09	88	6	-32	-563	-975	23417	17337	2	20	3.5	3.25
10/08/09	to	11/06/09	11/09/09	to	11/13/09	0	0	0	0	0	23417	17337	2	70	3.5	3

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
10/15/09	to	11/13/09	11/16/09	to	11/20/09	0	0	0	0	0	23417	17337	2	70	3.5	3.5
10/22/09	to	11/20/09	11/23/09	to	11/27/09	-38	1	-58	-38	-38	23379	17279	2	70	3.25	3.5
10/29/09	to	11/27/09	11/30/09	to	12/04/09	2063	1	2043	0	0	25442	19322	2	70	3.25	3.5
11/05/09	to	12/04/09	12/07/09	to	12/11/09	825	2	785	-63	-63	26267	20107	2	60	3.25	2.75
11/12/09	to	12/11/09	12/14/09	to	12/18/09	-1475	2	-1515	-950	-1475	24792	18592	2	70	2	3.25
11/19/09	to	12/18/09	12/21/09	to	12/25/09	-400	1	-420	-400	-400	24392	18172	2	30	2.75	3
11/26/09	to	12/25/09	12/28/09	to	01/01/10	150	3	90	-188	-188	24542	18262	2	70	2.25	2.5
12/03/09	to	01/01/10	01/04/10	to	01/08/10	-1100	3	-1160	-888	-1488	23442	17102	2	70	2.25	3.25
12/10/09	to	01/08/10	01/11/10	to	01/15/10	-113	1	-133	-113	-113	23329	16969	2	20	3.5	3
12/17/09	to	01/15/10	01/18/10	to	01/22/10	-1525	3	-1585	-788	-1525	21804	15384	2	40	3.25	2
12/24/09	to	01/22/10	01/25/10	to	01/29/10	0	0	0	0	0	21804	15384	2	50	3.5	3.5
12/31/09	to	01/29/10	02/01/10	to	02/05/10	0	0	0	0	0	21804	15384	2	70	2.25	3.5
01/07/10	to	02/05/10	02/08/10	to	02/12/10	300	4	220	-138	-138	22104	15604	2	70	2.25	3.5
01/14/10	to	02/12/10	02/15/10	to	02/19/10	825	4	745	-13	-13	22929	16349	2	70	2.25	3
01/21/10	to	02/19/10	02/22/10	to	02/26/10	-1238	2	-1278	-1050	-1238	21691	15071	2	60	2.75	3.25
01/28/10	to	02/26/10	03/01/10	to	03/05/10	-213	1	-233	-213	-213	21478	14838	2	70	3.25	3.5
02/04/10	to	03/05/10	03/08/10	to	03/12/10	0	0	0	0	0	21478	14838	2	70	3.25	3.5
02/11/10	to	03/12/10	03/15/10	to	03/19/10	-200	1	-220	-200	-200	21278	14618	2	70	3.25	3.5
02/18/10	to	03/19/10	03/22/10	to	03/26/10	0	0	0	0	0	21278	14618	2	70	3.25	3
02/25/10	to	03/26/10	03/29/10	to	04/02/10	100	1	80	0	0	21378	14698	2	70	2.75	3
03/04/10	to	04/02/10	04/05/10	to	04/09/10	288	1	268	0	0	21666	14966	2	40	3.25	3.25
03/11/10	to	04/09/10	04/12/10	to	04/16/10	0	0	0	0	0	21666	14966	2	30	3.25	3.25
03/18/10	to	04/16/10	04/19/10	to	04/23/10	950	1	930	0	0	22616	15896	2	30	3.25	3.25
03/25/10	to	04/23/10	04/26/10	to	04/30/10	288	4	208	-338	-600	22904	16104	2	40	3.5	2.25
04/01/10	to	04/30/10	05/03/10	to	05/07/10	788	4	708	-825	-825	23692	16812	2	30	3.5	3.5
04/08/10	to	05/07/10	05/10/10	to	05/14/10	2350	3	2290	-13	-13	26042	19102	2	30	3.5	3.5
04/15/10	to	05/14/10	05/17/10	to	05/21/10	4800	5	4700	-463	-463	30842	23802	2	70	2.5	3.25
04/22/10	to	05/21/10	05/24/10	to	05/28/10	1838	5	1738	-713	-713	32680	25540	2	60	2.25	2.75
04/29/10	to	05/28/10	05/31/10	to	06/04/10	500	5	400	-613	-613	33180	25940	2	50	1.75	2.75
05/06/10	to	06/04/10	06/07/10	to	06/11/10	1138	5	1038	-288	-288	34318	26978	2	50	3.5	1.5
05/13/10	to	06/11/10	06/14/10	to	06/18/10	0	1	-20	0	0	34318	26958	2	30	3.5	3
05/20/10	to	06/18/10	06/21/10	to	06/25/10	1288	4	1208	-413	-413	35606	28166	2	40	1.5	3
05/27/10	to	06/25/10	06/28/10	to	07/02/10	775	1	755	0	0	36381	28921	2	30	3.5	3.25
06/03/10	to	07/02/10	07/05/10	to	07/09/10	-138	1	-158	-138	-138	36243	28763	2	50	3	3.5
06/10/10	to	07/09/10	07/12/10	to	07/16/10	0	0	0	0	0	36243	28763	2	50	3.5	3.5
06/17/10	to	07/16/10	07/19/10	to	07/23/10	-888	2	-928	-1125	-1125	35355	27835	2	60	3.5	2.75
06/24/10	to	07/23/10	07/26/10	to	07/30/10	0	0	0	0	0	35355	27835	2	40	3.5	3.25
07/01/10	to	07/30/10	08/02/10	to	08/06/10	600	2	560	0	0	35955	28395	2	40	3.5	3.25
07/08/10	to	08/06/10	08/09/10	to	08/13/10	1238	3	1178	0	0	37193	29573	2	70	3	2.5
07/15/10	to	08/13/10	08/16/10	to	08/20/10	-1238	2	-1278	-1150	-1238	35955	28295	2	60	2.5	3.25
07/22/10	to	08/20/10	08/23/10	to	08/27/10	-425	2	-465	-463	-463	35530	27830	2	30	3.25	3
07/29/10	to	08/27/10	08/30/10	to	09/03/10	0	0	0	0	0	35530	27830	2	70	3.5	3
08/05/10	to	09/03/10	09/06/10	to	09/10/10	0	0	0	0	0	35530	27830	2	70	3.5	3.25
08/12/10	to	09/10/10	09/13/10	to	09/17/10	838	1	818	0	0	36368	28648	2	70	3.5	2.75
08/19/10	to	09/17/10	09/20/10	to	09/24/10	13	3	-47	-375	-625	36381	28601	2	30	2.75	3
08/26/10	to	09/24/10	09/27/10	to	10/01/10	300	2	260	-75	-75	36681	28861	2	40	3	2.5
09/02/10	to	10/01/10	10/04/10	to	10/08/10	-213	2	-253	-775	-775	36468	28608	2	60	3.25	2.25
09/09/10	to	10/08/10	10/11/10	to	10/15/10	1125	2	1085	-75	-75	37593	29693	2	60	3.5	2.5
09/16/10	to	10/15/10	10/18/10	to	10/22/10	2663	3	2603	0	0	40256	32296	2	70	3.25	2.25
09/23/10	to	10/22/10	10/25/10	to	10/29/10	0	0	0	0	0	40256	32296	2	70	3.25	3.25
09/30/10	to	10/29/10	11/01/10	to	11/05/10	25	1	5	0	0	40281	32301	2	70	3.25	3.25
10/07/10	to	11/05/10	11/08/10	to	11/12/10	-825	1	-845	-825	-825	39456	31456	2	70	3.25	3.25
10/14/10	to	11/12/10	11/15/10	to	11/19/10	0	0	0	0	0	39456	31456	2	60	2.5	3.25
10/21/10	to	11/19/10	11/22/10	to	11/26/10	550	1	530	0	0	40006	31986	2	60	2.5	2.75
10/28/10	to	11/26/10	11/29/10	to	12/03/10	-625	5	-725	-1100	-1575	39381	31261	2	70	3.25	2.5
11/04/10	to	12/03/10	12/06/10	to	12/10/10	-525	1	-545	-525	-525	38856	30716	2	40	3.25	3.25
11/11/10	to	12/10/10	12/13/10	to	12/17/10	-163	1	-183	-163	-163	38693	30533	2	40	3.25	3.25
11/18/10	to	12/17/10	12/20/10	to	12/24/10	-88	1	-108	-88	-88	38605	30425	2	40	3	3.25

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
11/25/10	to	12/24/10	12/27/10	to	12/31/10	1425	2	1385	0	0	40030	31810	2	40	3.25	3.25
12/02/10	to	12/31/10	01/03/11	to	01/07/11	-313	2	-353	-400	-400	39717	31457	2	70	3.25	3.5
12/09/10	to	01/07/11	01/10/11	to	01/14/11	2775	2	2735	0	0	42492	34192	2	70	2.75	3.5
12/16/10	to	01/14/11	01/17/11	to	01/21/11	-963	1	-983	-963	-963	41529	33209	2	70	3	3.5
12/23/10	to	01/21/11	01/24/11	to	01/28/11	-1013	3	-1073	-788	-1425	40516	32136	2	60	3.5	2.5
12/30/10	to	01/28/11	01/31/11	to	02/04/11	625	1	605	0	0	41141	32741	2	70	3	3
01/06/11	to	02/04/11	02/07/11	to	02/11/11	0	0	0	0	0	41141	32741	2	70	3	3.5
01/13/11	to	02/11/11	02/14/11	to	02/18/11	813	1	793	0	0	41954	33534	2	70	3.25	2.5
01/20/11	to	02/18/11	02/21/11	to	02/25/11	0	0	0	0	0	41954	33534	2	70	2.75	2.5
01/27/11	to	02/25/11	02/28/11	to	03/04/11	813	4	733	-75	-75	42767	34267	2	20	2.5	3.25
02/03/11	to	03/04/11	03/07/11	to	03/11/11	0	0	0	0	0	42767	34267	2	70	2.25	2.25
02/10/11	to	03/11/11	03/14/11	to	03/18/11	625	2	585	0	0	43392	34852	2	70	2.5	2.25
02/17/11	to	03/18/11	03/21/11	to	03/25/11	-1100	6	-1220	-1050	-1788	42292	33632	2	70	2.75	1.25
02/24/11	to	03/25/11	03/28/11	to	04/01/11	525	2	485	-575	-575	42817	34117	2	60	3.25	2.75
03/03/11	to	04/01/11	04/04/11	to	04/08/11	0	0	0	0	0	42817	34117	2	60	3.25	2.75
03/10/11	to	04/08/11	04/11/11	to	04/15/11	0	0	0	0	0	42817	34117	2	30	3.25	3.5
03/17/11	to	04/15/11	04/18/11	to	04/22/11	-850	2	-890	-988	-988	41967	33227	2	40	3	3
03/24/11	to	04/22/11	04/25/11	to	04/29/11	0	0	0	0	0	41967	33227	2	70	3.25	3.5
03/31/11	to	04/29/11	05/02/11	to	05/06/11	2375	3	2315	-1488	-1488	44342	35542	2	70	2.75	3
04/07/11	to	05/06/11	05/09/11	to	05/13/11	3188	4	3108	0	0	47530	38650	2	30	3.25	2.75
04/14/11	to	05/13/11	05/16/11	to	05/20/11	-825	2	-865	-700	-825	46705	37785	2	70	3	3.25
04/21/11	to	05/20/11	05/23/11	to	05/27/11	-288	2	-328	-188	-288	46417	37457	2	70	3	3.25
04/28/11	to	05/27/11	05/30/11	to	06/03/11	1450	1	1430	0	0	47867	38887	2	30	3.25	3.25
05/05/11	to	06/03/11	06/06/11	to	06/10/11	413	1	393	0	0	48280	39280	2	70	3	3
05/12/11	to	06/10/11	06/13/11	to	06/17/11	438	2	398	-188	-188	48718	39678	2	40	3.5	3.25
05/19/11	to	06/17/11	06/20/11	to	06/24/11	0	0	0	0	0	48718	39678	2	70	3.25	3.5
05/26/11	to	06/24/11	06/27/11	to	07/01/11	13	3	-47	-250	-463	48731	39631	2	50	3.25	3.5
06/02/11	to	07/01/11	07/04/11	to	07/08/11	-100	4	-180	-513	-513	48631	39451	2	50	3.25	3.25
06/09/11	to	07/08/11	07/11/11	to	07/15/11	1650	3	1590	0	0	50281	41041	2	50	3	3.25
06/16/11	to	07/15/11	07/18/11	to	07/22/11	1525	2	1485	-113	-113	51806	42526	2	50	3.25	2.75
06/23/11	to	07/22/11	07/25/11	to	07/29/11	1000	2	960	0	0	52806	43486	2	30	3.5	2.5
06/30/11	to	07/29/11	08/01/11	to	08/05/11	1888	4	1808	0	0	54694	45294	2	70	3.5	2.25
07/07/11	to	08/05/11	08/08/11	to	08/12/11	1263	5	1163	-950	-950	55957	46457	2	30	2.5	3
07/14/11	to	08/12/11	08/15/11	to	08/19/11	250	5	150	-450	-625	56207	46607	2	70	3.25	2.5
07/21/11	to	08/19/11	08/22/11	to	08/26/11	-875	5	-975	-838	-1450	55332	45632	2	70	3.25	2.5
07/28/11	to	08/26/11	08/29/11	to	09/02/11	0	0	0	0	0	55332	45632	2	70	2.75	3.5
08/04/11	to	09/02/11	09/05/11	to	09/09/11	1675	4	1595	-488	-488	57007	47227	2	70	2.5	3.5
08/11/11	to	09/09/11	09/12/11	to	09/16/11	-113	1	-133	-113	-113	56894	47094	2	70	3	3.5
08/18/11	to	09/16/11	09/19/11	to	09/23/11	-50	1	-70	-50	-50	56844	47024	2	70	3	3.5
08/25/11	to	09/23/11	09/26/11	to	09/30/11	138	2	98	-538	-538	56982	47122	2	70	2.5	3.5
09/01/11	to	09/30/11	10/03/11	to	10/07/11	1488	6	1368	-1063	-1063	58470	48490	2	50	2.75	3.5
09/08/11	to	10/07/11	10/10/11	to	10/14/11	-75	1	-95	-75	-75	58395	48395	2	60	2.75	3
09/15/11	to	10/14/11	10/17/11	to	10/21/11	363	2	323	-100	-100	58758	48718	2	60	2.75	3.5
09/22/11	to	10/21/11	10/24/11	to	10/28/11	1400	3	1340	0	0	60158	50058	2	40	3.25	3.25
09/29/11	to	10/28/11	10/31/11	to	11/04/11	-1888	7	-2028	-1588	-2713	58270	48030	2	60	3.25	2.25
10/06/11	to	11/04/11	11/07/11	to	11/11/11	0	0	0	0	0	58270	48030	2	70	3.5	3.5
10/13/11	to	11/11/11	11/14/11	to	11/18/11	0	0	0	0	0	58270	48030	2	70	3.5	3.5
10/20/11	to	11/18/11	11/21/11	to	11/25/11	0	0	0	0	0	58270	48030	2	70	3.5	3.5
10/27/11	to	11/25/11	11/28/11	to	12/02/11	-838	2	-878	-550	-838	57432	47152	2	70	3.5	3.5
11/03/11	to	12/02/11	12/05/11	to	12/09/11	138	2	98	-88	-88	57570	47250	2	40	3.5	3.5
11/10/11	to	12/09/11	12/12/11	to	12/16/11	1113	1	1093	0	0	58683	48343	2	50	3.25	3
11/17/11	to	12/16/11	12/19/11	to	12/23/11	0	0	0	0	0	58683	48343	2	60	3	3.25
11/24/11	to	12/23/11	12/26/11	to	12/30/11	838	1	818	0	0	59521	49161	2	60	2.75	3.25
12/01/11	to	12/30/11	01/02/12	to	01/06/12	0	0	0	0	0	59521	49161	2	60	2.5	3.25
12/08/11	to	01/06/12	01/09/12	to	01/13/12	925	2	885	0	0	60446	50046	2	70	2.5	3
12/15/11	to	01/13/12	01/16/12	to	01/20/12	25	2	-15	-75	-75	60471	50031	2	70	2.25	2.25
12/22/11	to	01/20/12	01/23/12	to	01/27/12	-788	7	-928	-713	-1350	59683	49103	2	60	2.25	1.5
12/29/11	to	01/27/12	01/30/12	to	02/03/12	-588	4	-668	-475	-1088	59095	48435	2	40	2.25	2.75

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
01/05/12	to	02/03/12	02/06/12	to	02/10/12	938	1	918	0	0	60033	49353	2	50	3.5	3.25
01/12/12	to	02/10/12	02/13/12	to	02/17/12	438	2	398	0	0	60471	49751	2	40	3.5	3.25
01/19/12	to	02/17/12	02/20/12	to	02/24/12	0	0	0	0	0	60471	49751	2	30	3.5	3.5
01/26/12	to	02/24/12	02/27/12	to	03/02/12	725	1	705	0	0	61196	50456	2	60	3.25	2.75
02/02/12	to	03/02/12	03/05/12	to	03/09/12	663	1	643	0	0	61859	51099	2	70	3.25	2
02/09/12	to	03/09/12	03/12/12	to	03/16/12	613	1	593	0	0	62472	51692	2	60	2.5	3.5
02/16/12	to	03/16/12	03/19/12	to	03/23/12	513	2	473	0	0	62985	52165	2	30	3	2.25
02/23/12	to	03/23/12	03/26/12	to	03/30/12	-113	1	-133	-113	-113	62872	52032	2	70	3.5	1.75
03/01/12	to	03/30/12	04/02/12	to	04/06/12	625	1	605	0	0	63497	52637	2	50	3.5	2.25
03/08/12	to	04/06/12	04/09/12	to	04/13/12	0	0	0	0	0	63497	52637	2	60	3.5	3.5
03/15/12	to	04/13/12	04/16/12	to	04/20/12	0	0	0	0	0	63497	52637	2	70	3.5	2.25
03/22/12	to	04/20/12	04/23/12	to	04/27/12	0	0	0	0	0	63497	52637	2	60	2.5	3
03/29/12	to	04/27/12	04/30/12	to	05/04/12	463	2	423	-13	-13	63960	53060	2	60	3	2
04/05/12	to	05/04/12	05/07/12	to	05/11/12	0	0	0	0	0	63960	53060	2	20	3.5	3.25
04/12/12	to	05/11/12	05/14/12	to	05/18/12	725	1	705	0	0	64685	53765	2	30	3	2.75
04/19/12	to	05/18/12	05/21/12	to	05/25/12	413	1	393	0	0	65098	54158	2	40	3	3.5
04/26/12	to	05/25/12	05/28/12	to	06/01/12	813	1	793	0	0	65911	54951	2	60	1.75	3.25
05/03/12	to	06/01/12	06/04/12	to	06/08/12	125	2	85	-363	-363	66036	55036	2	30	3	2.75
05/10/12	to	06/08/12	06/11/12	to	06/15/12	0	0	0	0	0	66036	55036	2	30	3	2.75
05/17/12	to	06/15/12	06/18/12	to	06/22/12	-2125	2	-2165	-1263	-2125	63911	52871	2	30	3.5	3.25
05/24/12	to	06/22/12	06/25/12	to	06/29/12	263	1	243	0	0	64174	53114	2	40	3.5	3.25
05/31/12	to	06/29/12	07/02/12	to	07/06/12	1175	2	1135	0	0	65349	54249	2	60	3	2.5
06/07/12	to	07/06/12	07/09/12	to	07/13/12	13	1	-7	0	0	65362	54242	2	70	2	2.75
06/14/12	to	07/13/12	07/16/12	to	07/20/12	-850	1	-870	-850	-850	64512	53372	2	70	3.5	3.25
06/21/12	to	07/20/12	07/23/12	to	07/27/12	-138	3	-198	-300	-400	64374	53174	2	30	3	3.5
06/28/12	to	07/27/12	07/30/12	to	08/03/12	1688	4	1608	-600	-600	66062	54782	2	30	3.25	3.5
07/05/12	to	08/03/12	08/06/12	to	08/10/12	0	0	0	0	0	66062	54782	2	30	3.5	3.5
07/12/12	to	08/10/12	08/13/12	to	08/17/12	0	0	0	0	0	66062	54782	2	40	3.5	3
07/19/12	to	08/17/12	08/20/12	to	08/24/12	0	0	0	0	0	66062	54782	2	30	3.5	3
07/26/12	to	08/24/12	08/27/12	to	08/31/12	13	1	-7	0	0	66075	54775	2	40	3.5	2.75
08/02/12	to	08/31/12	09/03/12	to	09/07/12	0	0	0	0	0	66075	54775	2	70	3.5	2.75
08/09/12	to	09/07/12	09/10/12	to	09/14/12	363	3	303	-513	-513	66438	55078	2	70	2.5	3
08/16/12	to	09/14/12	09/17/12	to	09/21/12	-638	1	-658	-638	-638	65800	54420	2	30	3.25	2.75
08/23/12	to	09/21/12	09/24/12	to	09/28/12	125	1	105	0	0	65925	54525	2	30	3.5	2.75
08/30/12	to	09/28/12	10/01/12	to	10/05/12	0	0	0	0	0	65925	54525	2	30	3.5	2.75
09/06/12	to	10/05/12	10/08/12	to	10/12/12	525	1	505	0	0	66450	55030	2	70	3.5	1.75
09/13/12	to	10/12/12	10/15/12	to	10/19/12	0	0	0	0	0	66450	55030	2	20	3	2.5
09/20/12	to	10/19/12	10/22/12	to	10/26/12	-100	1	-120	-100	-100	66350	54910	2	50	2.75	1.75
09/27/12	to	10/26/12	10/29/12	to	11/02/12	400	1	380	0	0	66750	55290	2	20	2.75	3
10/04/12	to	11/02/12	11/05/12	to	11/09/12	0	0	0	0	0	66750	55290	2	20	2.5	2.75
10/11/12	to	11/09/12	11/12/12	to	11/16/12	-350	1	-370	-350	-350	66400	54920	2	70	2	1.75
10/18/12	to	11/16/12	11/19/12	to	11/23/12	0	0	0	0	0	66400	54920	2	20	2.75	2.5
10/25/12	to	11/23/12	11/26/12	to	11/30/12	25	2	-15	-113	-113	66425	54905	2	40	1.5	2.5
11/01/12	to	11/30/12	12/03/12	to	12/07/12	-88	1	-108	-88	-88	66337	54797	2	70	1.5	3.5
11/08/12	to	12/07/12	12/10/12	to	12/14/12	413	2	373	0	0	66750	55170	2	70	1.5	2.5
11/15/12	to	12/14/12	12/17/12	to	12/21/12	0	0	0	0	0	66750	55170	2	60	2.5	2.5
11/22/12	to	12/21/12	12/24/12	to	12/28/12	-450	2	-490	-325	-450	66300	54680	2	40	2.25	2
11/29/12	to	12/28/12	12/31/12	to	01/04/13	263	2	223	-13	-13	66563	54903	2	70	2.5	2.5
12/06/12	to	01/04/13	01/07/13	to	01/11/13	1200	2	1160	0	0	67763	56063	2	40	3	3
12/13/12	to	01/11/13	01/14/13	to	01/18/13	-163	1	-183	-163	-163	67600	55880	2	50	2.25	3
12/20/12	to	01/18/13	01/21/13	to	01/25/13	-413	1	-433	-413	-413	67187	55447	2	70	3.25	2.25
12/27/12	to	01/25/13	01/28/13	to	02/01/13	-238	1	-258	-238	-238	66949	55189	2	50	3.5	3.25
01/03/13	to	02/01/13	02/04/13	to	02/08/13	1175	1	1155	0	0	68124	56344	2	70	3.5	3
01/10/13	to	02/08/13	02/11/13	to	02/15/13	0	0	0	0	0	68124	56344	2	60	3.5	3
01/17/13	to	02/15/13	02/18/13	to	02/22/13	188	1	168	0	0	68312	56512	2	50	3	3.25
01/24/13	to	02/22/13	02/25/13	to	03/01/13	1575	1	1555	0	0	69887	58067	2	70	2.25	3.25
01/31/13	to	03/01/13	03/04/13	to	03/08/13	1338	2	1298	0	0	71225	59365	2	30	1.5	2.25
02/07/13	to	03/08/13	03/11/13	to	03/15/13	-575	4	-655	-475	-575	70650	58710	2	50	1.25	2.25

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
02/14/13	to	03/15/13	03/18/13	to	03/22/13	-413	4	-493	-300	-413	70237	58217	2	50	1.75	3.25
02/21/13	to	03/22/13	03/25/13	to	03/29/13	0	0	0	0	0	70237	58217	2	40	2.25	3.5
02/28/13	to	03/29/13	04/01/13	to	04/05/13	1463	2	1423	0	0	71700	59640	2	70	2	3.25
03/07/13	to	04/05/13	04/08/13	to	04/12/13	75	1	55	0	0	71775	59695	2	50	2.5	2.75
03/14/13	to	04/12/13	04/15/13	to	04/19/13	875	1	855	0	0	72650	60550	2	30	3.5	3
03/21/13	to	04/19/13	04/22/13	to	04/26/13	188	1	168	0	0	72838	60718	2	40	3.5	2.5
03/28/13	to	04/26/13	04/29/13	to	05/03/13	663	7	523	-688	-725	73501	61241	2	50	3.5	1.25
04/04/13	to	05/03/13	05/06/13	to	05/10/13	25	1	5	0	0	73526	61246	2	60	3.25	3
04/11/13	to	05/10/13	05/13/13	to	05/17/13	25	1	5	0	0	73551	61251	2	20	3.5	3.5
04/18/13	to	05/17/13	05/20/13	to	05/24/13	250	2	210	-800	-800	73801	61461	2	20	3.5	3.5
04/25/13	to	05/24/13	05/27/13	to	05/31/13	-138	2	-178	-88	-138	73663	61283	2	50	3	3
05/02/13	to	05/31/13	06/03/13	to	06/07/13	138	3	78	-350	-663	73801	61361	2	50	3	2.75
05/09/13	to	06/07/13	06/10/13	to	06/14/13	0	0	0	0	0	73801	61361	2	70	3	2.5
05/16/13	to	06/14/13	06/17/13	to	06/21/13	1088	2	1048	0	0	74889	62409	2	70	3	2.5
05/23/13	to	06/21/13	06/24/13	to	06/28/13	-13	1	-33	-13	-13	74876	62376	2	70	3.5	3
05/30/13	to	06/28/13	07/01/13	to	07/05/13	25	1	5	0	0	74901	62381	2	70	3.5	3
06/06/13	to	07/05/13	07/08/13	to	07/12/13	-600	2	-640	-513	-600	74301	61741	2	70	2.25	3.5
06/13/13	to	07/12/13	07/15/13	to	07/19/13	0	0	0	0	0	74301	61741	2	70	3	3.25
06/20/13	to	07/19/13	07/22/13	to	07/26/13	0	0	0	0	0	74301	61741	2	70	3.25	2.75
06/27/13	to	07/26/13	07/29/13	to	08/02/13	38	1	18	0	0	74339	61759	2	70	3.25	2.75
07/04/13	to	08/02/13	08/05/13	to	08/09/13	0	0	0	0	0	74339	61759	2	70	3.5	3.5
07/11/13	to	08/09/13	08/12/13	to	08/16/13	-1313	1	-1333	-1313	-1313	73026	60426	2	60	3.5	2.5
07/18/13	to	08/16/13	08/19/13	to	08/23/13	-125	1	-145	-125	-125	72901	60281	2	70	2.5	2.5
07/25/13	to	08/23/13	08/26/13	to	08/30/13	-238	1	-258	-238	-238	72663	60023	2	50	3.25	2.5
08/01/13	to	08/30/13	09/02/13	to	09/06/13	663	1	643	0	0	73326	60666	2	30	3.25	2.75
08/08/13	to	09/06/13	09/09/13	to	09/13/13	0	0	0	0	0	73326	60666	2	40	2.75	3.5
08/15/13	to	09/13/13	09/16/13	to	09/20/13	725	1	705	0	0	74051	61371	2	40	2.75	3.5
08/22/13	to	09/20/13	09/23/13	to	09/27/13	0	0	0	0	0	74051	61371	2	70	2.5	2.25
08/29/13	to	09/27/13	09/30/13	to	10/04/13	-38	4	-118	-263	-375	74013	61253	2	60	2.5	1.25
09/05/13	to	10/04/13	10/07/13	to	10/11/13	0	0	0	0	0	74013	61253	2	60	2.25	2.5
09/12/13	to	10/11/13	10/14/13	to	10/18/13	-600	1	-620	-600	-600	73413	60633	2	70	3.25	1.75
09/19/13	to	10/18/13	10/21/13	to	10/25/13	513	1	493	0	0	73926	61126	2	50	2	2.5
09/26/13	to	10/25/13	10/28/13	to	11/01/13	75	3	15	-575	-575	74001	61141	2	20	3	2.5
10/03/13	to	11/01/13	11/04/13	to	11/08/13	1350	4	1270	-263	-263	75351	62411	2	30	2.25	2.75
10/10/13	to	11/08/13	11/11/13	to	11/15/13	175	2	135	-113	-113	75526	62546	2	70	1.75	3.25
10/17/13	to	11/15/13	11/18/13	to	11/22/13	400	1	380	0	0	75926	62926	2	70	1.75	3.25
10/24/13	to	11/22/13	11/25/13	to	11/29/13	0	0	0	0	0	75926	62926	2	70	3.25	2
10/31/13	to	11/29/13	12/02/13	to	12/06/13	963	2	923	0	0	76889	63849	2	20	3.5	3.5
11/07/13	to	12/06/13	12/09/13	to	12/13/13	0	0	0	0	0	76889	63849	2	70	2.75	2.25
11/14/13	to	12/13/13	12/16/13	to	12/20/13	0	0	0	0	0	76889	63849	2	70	2.75	2.25
11/21/13	to	12/20/13	12/23/13	to	12/27/13	0	0	0	0	0	76889	63849	2	50	2.25	2.5
11/28/13	to	12/27/13	12/30/13	to	01/03/14	0	0	0	0	0	76889	63849	2	50	2.25	2.5
12/05/13	to	01/03/14	01/06/14	to	01/10/14	-100	2	-140	-400	-400	76789	63709	2	50	2.25	2.25
12/12/13	to	01/10/14	01/13/14	to	01/17/14	0	0	0	0	0	76789	63709	2	20	2.25	3
12/19/13	to	01/17/14	01/20/14	to	01/24/14	250	2	210	-50	-50	77039	63919	2	20	2	3.25
12/26/13	to	01/24/14	01/27/14	to	01/31/14	0	0	0	0	0	77039	63919	2	50	3	2.25
01/02/14	to	01/31/14	02/03/14	to	02/07/14	488	2	448	0	0	77527	64367	2	30	3	2.25
01/09/14	to	02/07/14	02/10/14	to	02/14/14	-50	1	-70	-50	-50	77477	64297	2	50	3.5	2
01/16/14	to	02/14/14	02/17/14	to	02/21/14	0	0	0	0	0	77477	64297	2	60	3	2
01/23/14	to	02/21/14	02/24/14	to	02/28/14	-363	2	-403	-288	-363	77114	63894	2	60	3	1.75
01/30/14	to	02/28/14	03/03/14	to	03/07/14	688	3	628	-100	-100	77802	64522	2	20	3.25	2.25
02/06/14	to	03/07/14	03/10/14	to	03/14/14	13	1	-7	0	0	77815	64515	2	70	3.5	2.25
02/13/14	to	03/14/14	03/17/14	to	03/21/14	300	1	280	0	0	78115	64795	2	60	3	2.25
02/20/14	to	03/21/14	03/24/14	to	03/28/14	-63	2	-103	-100	-100	78052	64692	2	70	2	3
02/27/14	to	03/28/14	03/31/14	to	04/04/14	0	1	-20	0	0	78052	64672	2	70	3.25	2.25
03/06/14	to	04/04/14	04/07/14	to	04/11/14	0	0	0	0	0	78052	64672	2	70	3.25	2.25
03/13/14	to	04/11/14	04/14/14	to	04/18/14	0	0	0	0	0	78052	64672	2	50	2.75	3
03/20/14	to	04/18/14	04/21/14	to	04/25/14	0	0	0	0	0	78052	64672	2	70	2	3.25

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
03/27/14	to	04/25/14	04/28/14	to	05/02/14	338	1	318	0	0	78390	64990	2	70	1.25	3
04/03/14	to	05/02/14	05/05/14	to	05/09/14	713	1	693	0	0	79103	65683	2	30	3	2.75
04/10/14	to	05/09/14	05/12/14	to	05/16/14	0	0	0	0	0	79103	65683	2	40	3.25	2.25
04/17/14	to	05/16/14	05/19/14	to	05/23/14	0	0	0	0	0	79103	65683	2	40	3.25	2.25
04/24/14	to	05/23/14	05/26/14	to	05/30/14	0	0	0	0	0	79103	65683	2	40	3.25	2.25
05/01/14	to	05/30/14	06/02/14	to	06/06/14	1600	3	1540	-175	-175	80703	67223	2	20	2.25	2
05/08/14	to	06/06/14	06/09/14	to	06/13/14	0	0	0	0	0	80703	67223	2	70	3	1.75
05/15/14	to	06/13/14	06/16/14	to	06/20/14	0	1	-20	0	0	80703	67203	2	70	3	1.5
05/22/14	to	06/20/14	06/23/14	to	06/27/14	0	0	0	0	0	80703	67203	2	70	2.25	1.5
05/29/14	to	06/27/14	06/30/14	to	07/04/14	38	1	18	0	0	80741	67221	2	70	2.25	1.5
06/05/14	to	07/04/14	07/07/14	to	07/11/14	0	0	0	0	0	80741	67221	2	60	3.25	2.25
06/12/14	to	07/11/14	07/14/14	to	07/18/14	0	0	0	0	0	80741	67221	2	70	1.5	2.25
06/19/14	to	07/18/14	07/21/14	to	07/25/14	0	0	0	0	0	80741	67221	2	20	1.75	3.5
06/26/14	to	07/25/14	07/28/14	to	08/01/14	0	0	0	0	0	80741	67221	2	70	1.5	2.25
07/03/14	to	08/01/14	08/04/14	to	08/08/14	-25	2	-65	-38	-38	80716	67156	2	60	1	2.75
07/10/14	to	08/08/14	08/11/14	to	08/15/14	-263	1	-283	-263	-263	80453	66873	2	30	1.5	2.75
07/17/14	to	08/15/14	08/18/14	to	08/22/14	-213	3	-273	-225	-300	80240	66600	2	70	2.75	1.25
07/24/14	to	08/22/14	08/25/14	to	08/29/14	0	0	0	0	0	80240	66600	2	30	3.25	2
07/31/14	to	08/29/14	09/01/14	to	09/05/14	1350	1	1330	0	0	81590	67930	2	30	3.25	1.75
08/07/14	to	09/05/14	09/08/14	to	09/12/14	25	1	5	0	0	81615	67935	2	60	2	1.75
08/14/14	to	09/12/14	09/15/14	to	09/19/14	-38	3	-98	-138	-263	81577	67837	2	40	1.5	2.25
08/21/14	to	09/19/14	09/22/14	to	09/26/14	125	1	105	0	0	81702	67942	2	70	1.75	1.75
08/28/14	to	09/26/14	09/29/14	to	10/03/14	-588	4	-668	-513	-1050	81114	67274	2	40	2	1.5
09/04/14	to	10/03/14	10/06/14	to	10/10/14	1163	2	1123	0	0	82277	68397	2	20	3	2
09/11/14	to	10/10/14	10/13/14	to	10/17/14	1888	4	1808	0	0	84165	70205	2	20	2.75	2
09/18/14	to	10/17/14	10/20/14	to	10/24/14	0	0	0	0	0	84165	70205	2	50	3.5	3.25
09/25/14	to	10/24/14	10/27/14	to	10/31/14	275	1	255	0	0	84440	70460	2	50	3.5	3.25
10/02/14	to	10/31/14	11/03/14	to	11/07/14	550	3	490	0	0	84990	70950	2	50	2	3.25
10/09/14	to	11/07/14	11/10/14	to	11/14/14	900	1	880	0	0	85890	71830	2	50	2.5	3.25
10/16/14	to	11/14/14	11/17/14	to	11/21/14	-38	1	-58	-38	-38	85852	71772	2	70	2.75	1.75
10/23/14	to	11/21/14	11/24/14	to	11/28/14	0	0	0	0	0	85852	71772	2	70	3	1.75
10/30/14	to	11/28/14	12/01/14	to	12/05/14	850	3	790	0	0	86702	72562	2	30	2.5	2.75
11/06/14	to	12/05/14	12/08/14	to	12/12/14	0	0	0	0	0	86702	72562	2	70	3.5	2.75
11/13/14	to	12/12/14	12/15/14	to	12/19/14	0	0	0	0	0	86702	72562	2	70	3.5	3.5
11/20/14	to	12/19/14	12/22/14	to	12/26/14	0	0	0	0	0	86702	72562	2	70	3	3.5
11/27/14	to	12/26/14	12/29/14	to	01/02/15	0	0	0	0	0	86702	72562	2	70	2.5	3.5
12/04/14	to	01/02/15	01/05/15	to	01/09/15	75	1	55	0	0	86777	72617	2	70	2.5	3.5
12/11/14	to	01/09/15	01/12/15	to	01/16/15	263	4	183	-275	-275	87040	72800	2	40	3.5	2.25
12/18/14	to	01/16/15	01/19/15	to	01/23/15	1763	3	1703	-188	-188	88803	74503	2	70	3	2.25
12/25/14	to	01/23/15	01/26/15	to	01/30/15	-688	1	-708	-688	-688	88115	73795	2	30	3.5	3.25
01/01/15	to	01/30/15	02/02/15	to	02/06/15	1713	2	1673	0	0	89828	75468	2	30	3.5	3.5
01/08/15	to	02/06/15	02/09/15	to	02/13/15	0	0	0	0	0	89828	75468	2	40	3.5	3
01/15/15	to	02/13/15	02/16/15	to	02/20/15	738	3	678	-13	-13	90566	76146	2	60	3	1.75
01/22/15	to	02/20/15	02/23/15	to	02/27/15	513	3	453	-463	-463	91079	76599	2	40	2.25	1.75
01/29/15	to	02/27/15	03/02/15	to	03/06/15	613	3	553	0	0	91692	77152	2	40	3.25	2
02/05/15	to	03/06/15	03/09/15	to	03/13/15	-2125	8	-2285	-850	-2125	89567	74867	2	30	2	2.25
02/12/15	to	03/13/15	03/16/15	to	03/20/15	313	3	253	-363	-363	89880	75120	2	70	2.25	3
02/19/15	to	03/20/15	03/23/15	to	03/27/15	525	4	445	-400	-400	90405	75565	2	40	2.25	3.5
02/26/15	to	03/27/15	03/30/15	to	04/03/15	125	1	105	0	0	90530	75670	2	60	3.5	3.5
03/05/15	to	04/03/15	04/06/15	to	04/10/15	0	0	0	0	0	90530	75670	2	50	3.5	3.5
03/12/15	to	04/10/15	04/13/15	to	04/17/15	300	2	260	0	0	90830	75930	2	60	3.25	3.5
03/19/15	to	04/17/15	04/20/15	to	04/24/15	225	2	185	0	0	91055	76115	2	60	2.75	3.5
03/26/15	to	04/24/15	04/27/15	to	05/01/15	-1125	2	-1165	-725	-1125	89930	74950	2	70	3.5	3.5
04/02/15	to	05/01/15	05/04/15	to	05/08/15	-50	1	-70	-50	-50	89880	74880	2	70	3.25	3.5
04/09/15	to	05/08/15	05/11/15	to	05/15/15	1438	2	1398	0	0	91318	76278	2	70	2.75	3.5
04/16/15	to	05/15/15	05/18/15	to	05/22/15	1063	1	1043	0	0	92381	77321	2	50	3.25	3.5
04/23/15	to	05/22/15	05/25/15	to	05/29/15	-1475	2	-1515	-775	-1475	90906	75806	2	70	3.5	1.75
04/30/15	to	05/29/15	06/01/15	to	06/05/15	1813	5	1713	-50	-50	92719	77519	2	60	3.5	1.5

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
05/07/15	to	06/05/15	06/08/15	to	06/12/15	2450	5	2350	0	0	95169	79869	2	70	1.25	2.75
05/14/15	to	06/12/15	06/15/15	to	06/19/15	-1300	3	-1360	-1075	-1300	93869	78509	2	60	3.5	1.5
05/21/15	to	06/19/15	06/22/15	to	06/26/15	-13	1	-33	-13	-13	93856	78476	2	20	3.5	2.5
05/28/15	to	06/26/15	06/29/15	to	07/03/15	-125	1	-145	-125	-125	93731	78331	2	60	3.5	3.25
06/04/15	to	07/03/15	07/06/15	to	07/10/15	0	0	0	0	0	93731	78331	2	60	2.75	3.5
06/11/15	to	07/10/15	07/13/15	to	07/17/15	0	0	0	0	0	93731	78331	2	60	2.75	2.5
06/18/15	to	07/17/15	07/20/15	to	07/24/15	0	0	0	0	0	93731	78331	2	60	2.75	2.5
06/25/15	to	07/24/15	07/27/15	to	07/31/15	625	2	585	-100	-100	94356	78916	2	60	2.75	2.5
07/02/15	to	07/31/15	08/03/15	to	08/07/15	138	4	58	-400	-775	94494	78974	2	30	2.5	2.5
07/09/15	to	08/07/15	08/10/15	to	08/14/15	0	0	0	0	0	94494	78974	2	50	3.25	3.25
07/16/15	to	08/14/15	08/17/15	to	08/21/15	-238	1	-258	-238	-238	94256	78716	2	50	3.25	3.25
07/23/15	to	08/21/15	08/24/15	to	08/28/15	175	2	135	0	0	94431	78851	2	70	2.75	3.5
07/30/15	to	08/28/15	08/31/15	to	09/04/15	275	1	255	0	0	94706	79106	2	70	3.5	3.5
08/06/15	to	09/04/15	09/07/15	to	09/11/15	0	0	0	0	0	94706	79106	2	60	3.5	3.25
08/13/15	to	09/11/15	09/14/15	to	09/18/15	125	1	105	0	0	94831	79211	2	60	3.25	3.25
08/20/15	to	09/18/15	09/21/15	to	09/25/15	0	0	0	0	0	94831	79211	2	60	3.5	3.25
08/27/15	to	09/25/15	09/28/15	to	10/02/15	-575	1	-595	-575	-575	94256	78616	2	60	3.5	3
09/03/15	to	10/02/15	10/05/15	to	10/09/15	0	0	0	0	0	94256	78616	2	30	3	3.5
09/10/15	to	10/09/15	10/12/15	to	10/16/15	650	2	610	0	0	94906	79226	2	20	3	3
09/17/15	to	10/16/15	10/19/15	to	10/23/15	2263	2	2223	0	0	97169	81449	2	20	3.25	3
09/24/15	to	10/23/15	10/26/15	to	10/30/15	400	3	340	-813	-813	97569	81789	2	30	2.25	3
10/01/15	to	10/30/15	11/02/15	to	11/06/15	-100	1	-120	-100	-100	97469	81669	2	70	2.25	3.5
10/08/15	to	11/06/15	11/09/15	to	11/13/15	163	3	103	-225	-225	97632	81772	2	40	1.5	3.25
10/15/15	to	11/13/15	11/16/15	to	11/20/15	38	1	18	0	0	97670	81790	2	70	1.75	2
10/22/15	to	11/20/15	11/23/15	to	11/27/15	0	0	0	0	0	97670	81790	2	30	1.5	3.5
10/29/15	to	11/27/15	11/30/15	to	12/04/15	3225	3	3165	-575	-575	100895	84955	2	40	2.75	2.5
11/05/15	to	12/04/15	12/07/15	to	12/11/15	-350	1	-370	-350	-350	100545	84585	2	30	3.5	3
11/12/15	to	12/11/15	12/14/15	to	12/18/15	-800	3	-860	-1000	-1000	99745	83725	2	30	3.25	2.5
11/19/15	to	12/18/15	12/21/15	to	12/25/15	0	0	0	0	0	99745	83725	2	30	3	2.5
11/26/15	to	12/25/15	12/28/15	to	01/01/16	138	2	98	0	0	99883	83823	2	60	2.75	1.25
12/03/15	to	01/01/16	01/04/16	to	01/08/16	-138	3	-198	-863	-863	99745	83625	2	30	3	2.75
12/10/15	to	01/08/16	01/11/16	to	01/15/16	-531	1	-551	-531	-531	99214	83074	2	50	2.5	3.5
12/17/15	to	01/15/16	01/18/16	to	01/22/16	-1225	1	-1245	-1225	-1225	97989	81829	2	70	3.25	2.5
12/24/15	to	01/22/16	01/25/16	to	01/29/16	0	0	0	0	0	97989	81829	2	40	2.5	3.5
12/31/15	to	01/29/16	02/01/16	to	02/05/16	444	2	404	-213	-213	98433	82233	2	40	2.5	3.5
01/07/16	to	02/05/16	02/08/16	to	02/12/16	0	0	0	0	0	98433	82233	2	70	3.5	3.5
01/14/16	to	02/12/16	02/15/16	to	02/19/16	0	0	0	0	0	98433	82233	2	70	3.5	3.5
01/21/16	to	02/19/16	02/22/16	to	02/26/16	0	0	0	0	0	98433	82233	2	70	3.5	3.5
01/28/16	to	02/26/16	02/29/16	to	03/04/16	-269	1	-289	-269	-269	98164	81944	2	70	2.25	3.5
02/04/16	to	03/04/16	03/07/16	to	03/11/16	1613	3	1553	-1394	-1456	99777	83497	2	70	2.5	3.5
02/11/16	to	03/11/16	03/14/16	to	03/18/16	650	1	630	0	0	100427	84127	2	30	3	3.25
02/18/16	to	03/18/16	03/21/16	to	03/25/16	0	0	0	0	0	100427	84127	2	30	3.25	2.75
02/25/16	to	03/25/16	03/28/16	to	04/01/16	294	2	254	-213	-213	100721	84381	2	40	2.5	3.5
03/03/16	to	04/01/16	04/04/16	to	04/08/16	-713	2	-753	-569	-713	100008	83628	2	30	3	1.75
03/10/16	to	04/08/16	04/11/16	to	04/15/16	-81	1	-101	-81	-81	99927	83527	2	60	2.5	2
03/17/16	to	04/15/16	04/18/16	to	04/22/16	588	1	568	0	0	100515	84095	2	50	3.5	2
03/24/16	to	04/22/16	04/25/16	to	04/29/16	0	0	0	0	0	100515	84095	2	60	3.5	2
03/31/16	to	04/29/16	05/02/16	to	05/06/16	0	0	0	0	0	100515	84095	2	60	2.75	2
04/07/16	to	05/06/16	05/09/16	to	05/13/16	25	1	5	0	0	100540	84100	2	30	2.75	2.75
04/14/16	to	05/13/16	05/16/16	to	05/20/16	219	1	199	0	0	100759	84299	2	30	2.75	2.25
04/21/16	to	05/20/16	05/23/16	to	05/27/16	-275	1	-295	-275	-275	100484	84004	2	70	2	2.75
04/28/16	to	05/27/16	05/30/16	to	06/03/16	1344	2	1304	-63	-63	101828	85308	2	50	2	2
05/05/16	to	06/03/16	06/06/16	to	06/10/16	-94	1	-114	-94	-94	101734	85194	2	30	1.75	2
05/12/16	to	06/10/16	06/13/16	to	06/17/16	1250	4	1170	0	0	102984	86364	2	50	1.25	3.5
05/19/16	to	06/17/16	06/20/16	to	06/24/16	75	5	-25	-194	-294	103059	86339	2	70	3	1.5
05/26/16	to	06/24/16	06/27/16	to	07/01/16	-181	3	-241	-413	-413	102878	86098	2	60	3	1.75
06/02/16	to	07/01/16	07/04/16	to	07/08/16	0	0	0	0	0	102878	86098	2	60	3.5	3
06/09/16	to	07/08/16	07/11/16	to	07/15/16	-144	1	-164	-144	-144	102734	85934	2	60	3	2.5

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
06/16/16	to	07/15/16	07/18/16	to	07/22/16	0	0	0	0	0	102734	85934	2	70	2.25	3
06/23/16	to	07/22/16	07/25/16	to	07/29/16	0	0	0	0	0	102734	85934	2	60	3	2.5
06/30/16	to	07/29/16	08/01/16	to	08/05/16	94	1	74	0	0	102828	86008	2	60	2	3.5
07/07/16	to	08/05/16	08/08/16	to	08/12/16	-700	1	-720	-700	-700	102128	85288	2	70	2.25	3.5
07/14/16	to	08/12/16	08/15/16	to	08/19/16	-63	2	-103	-63	-63	102065	85185	2	20	3	3
07/21/16	to	08/19/16	08/22/16	to	08/26/16	763	1	743	0	0	102828	85928	2	70	3.5	1.75
07/28/16	to	08/26/16	08/29/16	to	09/02/16	344	2	304	0	0	103172	86232	2	50	2.75	2.5
08/04/16	to	09/02/16	09/05/16	to	09/09/16	519	1	499	0	0	103691	86731	2	50	2.75	3.5
08/11/16	to	09/09/16	09/12/16	to	09/16/16	0	0	0	0	0	103691	86731	2	40	3	2.75
08/18/16	to	09/16/16	09/19/16	to	09/23/16	0	0	0	0	0	103691	86731	2	70	1.75	2.75
08/25/16	to	09/23/16	09/26/16	to	09/30/16	313	1	293	0	0	104004	87024	2	70	1.75	2.75
09/01/16	to	09/30/16	10/03/16	to	10/07/16	-119	1	-139	-119	-119	103885	86885	2	30	3.25	3
09/08/16	to	10/07/16	10/10/16	to	10/14/16	0	0	0	0	0	103885	86885	2	50	3	2.5
09/15/16	to	10/14/16	10/17/16	to	10/21/16	463	1	443	0	0	104348	87328	2	40	3.25	2
09/22/16	to	10/21/16	10/24/16	to	10/28/16	0	0	0	0	0	104348	87328	2	50	3	2.25
09/29/16	to	10/28/16	10/31/16	to	11/04/16	0	0	0	0	0	104348	87328	2	50	3	2.25
10/06/16	to	11/04/16	11/07/16	to	11/11/16	263	2	223	-769	-769	104611	87551	2	60	1.75	3
10/13/16	to	11/11/16	11/14/16	to	11/18/16	0	0	0	0	0	104611	87551	2	30	2.5	3.25
10/20/16	to	11/18/16	11/21/16	to	11/25/16	0	0	0	0	0	104611	87551	2	30	2.5	3.25
10/27/16	to	11/25/16	11/28/16	to	12/02/16	100	1	80	0	0	104711	87631	2	30	2.25	2.25
11/03/16	to	12/02/16	12/05/16	to	12/09/16	1344	2	1304	-156	-156	106055	88935	2	40	2	3
11/10/16	to	12/09/16	12/12/16	to	12/16/16	13	3	-47	-106	-106	106068	88888	2	30	2.25	2.75
11/17/16	to	12/16/16	12/19/16	to	12/23/16	-738	1	-758	-738	-738	105330	88130	2	40	2.25	3.5
11/24/16	to	12/23/16	12/26/16	to	12/30/16	0	0	0	0	0	105330	88130	2	50	2.75	3.5
12/01/16	to	12/30/16	01/02/17	to	01/06/17	-169	2	-209	-88	-169	105161	87921	2	50	2.75	3.5
12/08/16	to	01/06/17	01/09/17	to	01/13/17	763	1	743	0	0	105924	88664	2	50	2.75	3.5
12/15/16	to	01/13/17	01/16/17	to	01/20/17	-681	1	-701	-681	-681	105243	87963	2	70	2.25	3
12/22/16	to	01/20/17	01/23/17	to	01/27/17	0	0	0	0	0	105243	87963	2	70	2.25	2.5
12/29/16	to	01/27/17	01/30/17	to	02/03/17	0	0	0	0	0	105243	87963	2	70	2	2.5
01/05/17	to	02/03/17	02/06/17	to	02/10/17	0	0	0	0	0	105243	87963	2	70	2.5	2.5
01/12/17	to	02/10/17	02/13/17	to	02/17/17	0	0	0	0	0	105243	87963	2	60	1.75	3.25
01/19/17	to	02/17/17	02/20/17	to	02/24/17	300	1	280	0	0	105543	88243	2	60	1.75	3.25
01/26/17	to	02/24/17	02/27/17	to	03/03/17	56	1	36	0	0	105599	88279	2	70	1.75	3.25
02/02/17	to	03/03/17	03/06/17	to	03/10/17	-169	1	-189	-169	-169	105430	88090	2	20	3.5	2
02/09/17	to	03/10/17	03/13/17	to	03/17/17	194	1	174	0	0	105624	88264	2	30	2.75	2.25
02/16/17	to	03/17/17	03/20/17	to	03/24/17	0	0	0	0	0	105624	88264	2	40	2.75	1.75
02/23/17	to	03/24/17	03/27/17	to	03/31/17	-19	3	-79	-81	-119	105605	88185	2	40	2.75	1.75
03/02/17	to	03/31/17	04/03/17	to	04/07/17	-225	1	-245	-225	-225	105380	87940	2	60	3.5	1.25
03/09/17	to	04/07/17	04/10/17	to	04/14/17	0	0	0	0	0	105380	87940	2	70	3	1.25
03/16/17	to	04/14/17	04/17/17	to	04/21/17	0	1	-20	0	0	105380	87920	2	70	1.25	1.25
03/23/17	to	04/21/17	04/24/17	to	04/28/17	-838	5	-938	-775	-1156	104542	86982	2	70	1.25	1.25
03/30/17	to	04/28/17	05/01/17	to	05/05/17	13	1	-7	0	0	104555	86975	2	70	1.75	1.5
04/06/17	to	05/05/17	05/08/17	to	05/12/17	31	1	11	0	0	104586	86986	2	60	2.25	1.25
04/13/17	to	05/12/17	05/15/17	to	05/19/17	0	0	0	0	0	104586	86986	2	30	2.25	2.25
04/20/17	to	05/19/17	05/22/17	to	05/26/17	238	1	218	0	0	104824	87204	2	70	2	1.5
04/27/17	to	05/26/17	05/29/17	to	06/02/17	63	1	43	0	0	104887	87247	2	60	2.5	1.5
05/04/17	to	06/02/17	06/05/17	to	06/09/17	0	0	0	0	0	104887	87247	2	70	2.25	1.75
05/11/17	to	06/09/17	06/12/17	to	06/16/17	-400	2	-440	-400	-400	104487	86807	2	70	2.25	1.75
05/18/17	to	06/16/17	06/19/17	to	06/23/17	0	0	0	0	0	104487	86807	2	20	3	3.25
05/25/17	to	06/23/17	06/26/17	to	06/30/17	-913	2	-953	-863	-913	103574	85854	2	60	2.5	1.75
06/01/17	to	06/30/17	07/03/17	to	07/07/17	0	0	0	0	0	103574	85854	2	70	2	3.25
06/08/17	to	07/07/17	07/10/17	to	07/14/17	94	1	74	0	0	103668	85928	2	60	2	3.5
06/15/17	to	07/14/17	07/17/17	to	07/21/17	944	1	924	0	0	104612	86852	2	60	2.25	2.75
06/22/17	to	07/21/17	07/24/17	to	07/28/17	131	1	111	0	0	104743	86963	2	50	2.5	2.5
06/29/17	to	07/28/17	07/31/17	to	08/04/17	1356	2	1316	0	0	106099	88279	2	70	2	1.5
07/06/17	to	08/04/17	08/07/17	to	08/11/17	-1419	5	-1519	-656	-1894	104680	86760	2	30	3.5	1.25
07/13/17	to	08/11/17	08/14/17	to	08/18/17	519	1	499	0	0	105199	87259	2	50	1.75	3
07/20/17	to	08/18/17	08/21/17	to	08/25/17	244	1	224	0	0	105443	87483	2	60	2.75	2.5

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
07/27/17	to	08/25/17	08/28/17	to	09/01/17	0	0	0	0	0	105443	87483	2	60	3.5	3.25
08/03/17	to	09/01/17	09/04/17	to	09/08/17	-519	1	-539	-519	-519	104924	86944	2	60	3.5	3.25
08/10/17	to	09/08/17	09/11/17	to	09/15/17	0	0	0	0	0	104924	86944	2	70	2.25	3
08/17/17	to	09/15/17	09/18/17	to	09/22/17	538	1	518	0	0	105462	87462	2	70	2.25	2
08/24/17	to	09/22/17	09/25/17	to	09/29/17	0	0	0	0	0	105462	87462	2	70	2.25	3
08/31/17	to	09/29/17	10/02/17	to	10/06/17	0	0	0	0	0	105462	87462	2	40	3.25	2.75
09/07/17	to	10/06/17	10/09/17	to	10/13/17	-488	1	-508	-488	-488	104974	86954	2	40	2.75	2.75
09/14/17	to	10/13/17	10/16/17	to	10/20/17	0	0	0	0	0	104974	86954	2	30	2.5	3.5
09/21/17	to	10/20/17	10/23/17	to	10/27/17	-169	3	-229	-619	-619	104805	86725	2	20	2	3.5
09/28/17	to	10/27/17	10/30/17	to	11/03/17	150	1	130	0	0	104955	86855	2	60	2.25	1.5
10/05/17	to	11/03/17	11/06/17	to	11/10/17	0	0	0	0	0	104955	86855	2	20	3.5	3
10/12/17	to	11/10/17	11/13/17	to	11/17/17	0	0	0	0	0	104955	86855	2	50	2.25	3.25
10/19/17	to	11/17/17	11/20/17	to	11/24/17	0	0	0	0	0	104955	86855	2	60	2	1.5
10/26/17	to	11/24/17	11/27/17	to	12/01/17	-250	3	-310	-169	-250	104705	86545	2	60	2	1.5
11/02/17	to	12/01/17	12/04/17	to	12/08/17	0	0	0	0	0	104705	86545	2	30	2.75	2
11/09/17	to	12/08/17	12/11/17	to	12/15/17	388	1	368	0	0	105093	86913	2	60	1.75	2.5
11/16/17	to	12/15/17	12/18/17	to	12/22/17	-231	1	-251	-231	-231	104862	86662	2	50	2	1.5
11/23/17	to	12/22/17	12/25/17	to	12/29/17	0	0	0	0	0	104862	86662	2	50	1.75	2.75
11/30/17	to	12/29/17	01/01/18	to	01/05/18	0	0	0	0	0	104862	86662	2	50	1.75	2.75
12/07/17	to	01/05/18	01/08/18	to	01/12/18	444	1	424	0	0	105306	87086	2	40	2	2.25
12/14/17	to	01/12/18	01/15/18	to	01/19/18	-881	1	-901	-881	-881	104425	86185	2	70	3.5	1.5
12/21/17	to	01/19/18	01/22/18	to	01/26/18	163	2	123	-400	-400	104588	86308	2	50	1.5	1.75
12/28/17	to	01/26/18	01/29/18	to	02/02/18	-181	1	-201	-181	-181	104407	86107	2	40	3	2.5
01/04/18	to	02/02/18	02/05/18	to	02/09/18	0	0	0	0	0	104407	86107	2	50	2.75	2.75
01/11/18	to	02/09/18	02/12/18	to	02/16/18	-344	2	-384	-1119	-1119	104063	85723	2	50	2.75	2.75
01/18/18	to	02/16/18	02/19/18	to	02/23/18	0	0	0	0	0	104063	85723	2	30	2.5	3.25
01/25/18	to	02/23/18	02/26/18	to	03/02/18	550	1	530	0	0	104613	86253	2	30	2.5	3.25
02/01/18	to	03/02/18	03/05/18	to	03/09/18	525	1	505	0	0	105138	86758	2	70	2.75	2.5
02/08/18	to	03/09/18	03/12/18	to	03/16/18	0	0	0	0	0	105138	86758	2	40	3.5	2.25
02/15/18	to	03/16/18	03/19/18	to	03/23/18	319	2	279	-19	-19	105457	87037	2	40	2.75	2
02/22/18	to	03/23/18	03/26/18	to	03/30/18	594	1	574	0	0	106051	87611	2	70	2	1.75
03/01/18	to	03/30/18	04/02/18	to	04/06/18	-388	3	-448	-188	-388	105663	87163	2	70	2.25	1.25
03/08/18	to	04/06/18	04/09/18	to	04/13/18	-56	1	-76	-56	-56	105607	87087	2	70	2	3.25
03/15/18	to	04/13/18	04/16/18	to	04/20/18	0	0	0	0	0	105607	87087	2	70	2	2.5
03/22/18	to	04/20/18	04/23/18	to	04/27/18	363	1	343	0	0	105970	87430	2	60	2	2.25
03/29/18	to	04/27/18	04/30/18	to	05/04/18	-919	4	-999	-413	-919	105051	86431	2	70	2.5	1.5
04/05/18	to	05/04/18	05/07/18	to	05/11/18	-81	1	-101	-81	-81	104970	86330	2	70	2.25	3.25
04/12/18	to	05/11/18	05/14/18	to	05/18/18	0	0	0	0	0	104970	86330	2	70	1.75	3.25
04/19/18	to	05/18/18	05/21/18	to	05/25/18	0	0	0	0	0	104970	86330	2	70	1.75	3.25
04/26/18	to	05/25/18	05/28/18	to	06/01/18	-144	1	-164	-144	-144	104826	86166	2	70	1.75	3.25
05/03/18	to	06/01/18	06/04/18	to	06/08/18	0	0	0	0	0	104826	86166	2	50	2.75	2.25
05/10/18	to	06/08/18	06/11/18	to	06/15/18	1675	2	1635	-25	-25	106501	87801	2	70	2.5	2
05/17/18	to	06/15/18	06/18/18	to	06/22/18	194	1	174	0	0	106695	87975	2	20	3.5	3
05/24/18	to	06/22/18	06/25/18	to	06/29/18	-44	2	-84	-63	-63	106651	87891	2	40	1.5	1.75
05/31/18	to	06/29/18	07/02/18	to	07/06/18	-44	2	-84	-119	-119	106607	87807	2	40	1	2.75
06/07/18	to	07/06/18	07/09/18	to	07/13/18	725	2	685	0	0	107332	88492	2	60	3.25	1
06/14/18	to	07/13/18	07/16/18	to	07/20/18	694	2	654	0	0	108026	89146	2	20	1.5	3.25
06/21/18	to	07/20/18	07/23/18	to	07/27/18	0	0	0	0	0	108026	89146	2	50	2.5	1.75
06/28/18	to	07/27/18	07/30/18	to	08/03/18	-31	2	-71	-131	-131	107995	89075	2	50	2.5	1.75
07/05/18	to	08/03/18	08/06/18	to	08/10/18	256	1	236	0	0	108251	89311	2	30	3.5	2
07/12/18	to	08/10/18	08/13/18	to	08/17/18	0	0	0	0	0	108251	89311	2	70	2.5	1.75
07/19/18	to	08/17/18	08/20/18	to	08/24/18	0	0	0	0	0	108251	89311	2	70	2.5	1.75
07/26/18	to	08/24/18	08/27/18	to	08/31/18	6	1	-14	0	0	108257	89297	2	70	1.5	3
08/02/18	to	08/31/18	09/03/18	to	09/07/18	131	1	111	0	0	108388	89408	2	50	1.5	3
08/09/18	to	09/07/18	09/10/18	to	09/14/18	113	2	73	-163	-163	108501	89481	2	70	1.75	2
08/16/18	to	09/14/18	09/17/18	to	09/21/18	50	1	30	0	0	108551	89511	2	70	2.25	3
08/23/18	to	09/21/18	09/24/18	to	09/28/18	119	2	79	-75	-75	108670	89590	2	60	3.5	1.5
08/30/18	to	09/28/18	10/01/18	to	10/05/18	0	0	0	0	0	108670	89590	2	30	3.25	3

In-Sample Dates			Out-Of-Sample Dates			osnp	ont	NOnp\$20	ollt	odd	EQ	NetEq	pw	N	vup	vdn
09/06/18	to	10/05/18	10/08/18	to	10/12/18	175	1	155	0	0	108845	89745	2	40	2.25	2.5
09/13/18	to	10/12/18	10/15/18	to	10/19/18	-25	1	-45	-25	-25	108820	89700	2	50	3.5	1.75
09/20/18	to	10/19/18	10/22/18	to	10/26/18	375	1	355	0	0	109195	90055	2	30	3	1.75
09/27/18	to	10/26/18	10/29/18	to	11/02/18	388	1	368	0	0	109583	90423	2	20	2.25	2
10/04/18	to	11/02/18	11/05/18	to	11/09/18	0	0	0	0	0	109583	90423	2	20	2.25	2.75
10/11/18	to	11/09/18	11/12/18	to	11/16/18	319	2	279	-69	-69	109902	90702	2	70	1.75	2
10/18/18	to	11/16/18	11/19/18	to	11/23/18	-88	1	-108	-88	-88	109814	90594	2	60	1.5	2.25
10/25/18	to	11/23/18	11/26/18	to	11/30/18	488	1	468	0	0	110302	91062	2	40	1.75	3
11/01/18	to	11/30/18	12/03/18	to	12/07/18	131	2	91	-144	-144	110433	91153	2	50	1.5	2
11/08/18	to	12/07/18	12/10/18	to	12/14/18	75	3	15	-294	-294	110508	91168	2	70	3.25	1.75
11/15/18	to	12/14/18	12/17/18	to	12/21/18	-488	2	-528	-706	-706	110020	90640	2	50	3.25	1.75
11/22/18	to	12/21/18	12/24/18	to	12/28/18	213	2	173	0	0	110233	90813	2	60	1.25	2.5
11/29/18	to	12/28/18	12/31/18	to	01/04/19	44	2	4	-100	-100	110277	90817	2	30	2.75	2.5
12/06/18	to	01/04/19	01/07/19	to	01/11/19	281	1	261	0	0	110558	91078	2	50	2.25	3
12/13/18	to	01/11/19	01/14/19	to	01/18/19	75	1	55	0	0	110633	91133	2	30	3	2
12/20/18	to	01/18/19	01/21/19	to	01/25/19	0	0	0	0	0	110633	91133	2	70	3.25	2.5
12/27/18	to	01/25/19	01/28/19	to	02/01/19	231	1	211	0	0	110864	91344	2	70	2.5	2.5
01/03/19	to	02/01/19	02/04/19	to	02/08/19	0	0	0	0	0	110864	91344	2	70	3.25	2.5
01/10/19	to	02/08/19	02/11/19	to	02/15/19	0	0	0	0	0	110864	91344	2	70	2.5	2.5
01/17/19	to	02/15/19	02/18/19	to	02/22/19	-213	1	-233	-213	-213	110651	91111	2	40	1.5	2.25
01/24/19	to	02/22/19	02/25/19	to	03/01/19	0	0	0	0	0	110651	91111	2	40	2.25	2
01/31/19	to	03/01/19	03/04/19	to	03/08/19	1050	2	1010	-138	-138	111701	92121	2	70	2	1.5
02/07/19	to	03/08/19	03/11/19	to	03/15/19	0	0	0	0	0	111701	92121	2	20	3	2.25
02/14/19	to	03/15/19	03/18/19	to	03/22/19	419	1	399	0	0	112120	92520	2	50	2.5	1.5
02/21/19	to	03/22/19	03/25/19	to	03/29/19	0	0	0	0	0	112120	92520	2	70	1	2.5
02/28/19	to	03/29/19	04/01/19	to	04/05/19	0	0	0	0	0	112120	92520	2	40	1	2.75
03/07/19	to	04/05/19	04/08/19	to	04/12/19	225	2	185	0	0	112345	92705	2	50	0.75	3.5
03/14/19	to	04/12/19	04/15/19	to	04/19/19	0	0	0	0	0	112345	92705	2	30	1.75	1.5
03/21/19	to	04/19/19	04/22/19	to	04/26/19	544	3	484	0	0	112889	93189	2	20	1.25	1.5
03/28/19	to	04/26/19	04/29/19	to	05/03/19	-350	3	-410	-563	-563	112539	92779	2	60	1	2.75
04/04/19	to	05/03/19	05/06/19	to	05/10/19	-75	1	-95	-75	-75	112464	92684	2	50	1.25	2
04/11/19	to	05/10/19	05/13/19	to	05/17/19	-144	1	-164	-144	-144	112320	92520	2	40	1.5	3.5
04/18/19	to	05/17/19	05/20/19	to	05/24/19	294	2	254	-288	-288	112614	92774	2	30	1.75	2.75
04/25/19	to	05/24/19	05/27/19	to	05/31/19	-406	1	-426	-406	-406	112208	92348	2	40	2.25	1.75
05/02/19	to	05/31/19	06/03/19	to	06/07/19	-375	3	-435	-769	-769	111833	91913	2	30	1.75	3.25
05/09/19	to	06/07/19	06/10/19	to	06/14/19	0	0	0	0	0	111833	91913	2	30	3.5	2
05/16/19	to	06/14/19	06/17/19	to	06/21/19	0	0	0	0	0	111833	91913	2	30	3.5	2
05/23/19	to	06/21/19	06/24/19	to	06/28/19	0	0	0	0	0	111833	91913	2	30	3.5	2

Appendix 1: n^{th} Order Fading Memory Polynomial Next Bar's Forecast Math

What is The N^{th} Order Fading Memory Polynomial?

This is a mathematical technique that fits a n^{th} order polynomial to the last T price bars but calculates the coefficients of the polynomial such that the error between the current n^{th} order polynomial and the current bar is weighted much higher than the error between the price T bars ago and the value of the n^{th} order polynomial T bars ago. As an example, if the latest price is at time t and the price made a turn at time bar $t-10$, then we do not want prices prior to $t-10$ affecting the current polynomial fit as much. As will be shown the most familiar case of this fading memory technique is the exponential moving average. The fading memory technique is in contrast to the Least Squares Polynomial fit, which weights all past errors between the polynomial and the price bar equally.

Consider a time series $x(t)$ where t is an integer value (a price bar number) like the number of days or minutes, etc from some starting time. Suppose we want to find at some given time some n^{th} -degree polynomial that fits the data well at current and recent prices but ignores the fit as we move into the distant past. One way to construct this type of fit would be to weight the past data with a number that got smaller and smaller the further back in time we went. If we let the polynomial function be represented by the symbol $\mathbf{p}(t-\tau)$ where $\mathbf{p}(t-0)$ is the current value of the polynomial, $\mathbf{p}(t-1)$ is the previous value of the polynomial, etc., then an error function can be formed that consists of the weighted sum of the squared difference between the price series $x(t-\tau)$ and the polynomial $\mathbf{p}(t-\tau)$ given by

$$\mathbf{error} = \sum \beta^{\tau} (x(t-\tau) - \mathbf{p}(t-\tau))^2 \quad \tau=0 \text{ to } \infty \quad (1)$$

where $0 < \beta < 1$ and β^{τ} is much much less than 1 for large τ .

It turns out that if we let the n^{th} degree polynomial $\mathbf{p}(t-\tau)$ be constructed as a linear combination of orthogonal polynomials called Meixner polynomials then minimizing the error with respect to the coefficients of the orthogonal polynomials yields the best estimate of $x(t-\tau)$ as $x_{\text{est}}(t-\tau)$ and given by the equation

$$x_{\text{est}}(t-\tau) = (1-\beta) \sum_{k=0}^n \beta^k b_{k,t} \Phi_k(t) |_{\tau} \quad (2)$$

Where

$$\Phi_n(t) = \sum_{k=0}^n \binom{n}{k} \binom{t}{k} z^k$$

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

$$b_{j,t} = \sum_{k=0}^{\infty} \beta^k \Phi_j(k) x(t-k)$$

$$z = 1 - 1/\beta$$

where n is the polynomial degree, $\Phi_k(\tau)$ are the Meixner polynomials of degree k ($k=0$ to n), and $\mathbf{b}_k(\mathbf{t})$ are the coefficients that minimize the error of equation (1). Generally the summation for $\mathbf{b}_j(\mathbf{t})$ can be terminated when $\beta^k \ll 1$.

For the exact mathematical solutions that produce equation (2) and the mathematical descriptions of the Meixner polynomials refer to Reference 1.

To yield the 1 day ahead prediction the above equation becomes;

$$x_{est}(t+1) = (1-\beta) \sum_{k=0}^n \beta^k b_{k,t} \Phi_k(-1) \quad k=0 \text{ to } n \quad (3)$$

After some algebraic manipulation with the Meixner polynomials the $b_{k,t}$ coefficients satisfy the following recursive relationship. (see Reference 1)

$$b_{k,t} = \beta b_{k,t-1} + b_{k-1,t} - b_{k-1,t-1}$$

One case is of immediate interest where the polynomial is a constant, that is $n=0$.

For this case the solution to equation (3) can be found after some algebraic manipulation to be:

$$X_{0,est} = \beta * X_{0,est}[1] + (1-\beta) * x(t) \quad (4)$$

Where $X_{0,est}[1]$ is the previous estimated value, $x(t)$ is the current bar's price and where the 0 in $X_{0,est}$ indicates that we are estimating a polynomial of degree 0 or simply a constant. If a change of variables is made letting $\alpha = (1-\beta)$ then equation (4) becomes:

$$X_{0,est} = (1-\alpha) * X_{0,est}[1] + \alpha * x(t) \quad (5)$$

This is the familiar formula for the exponential moving average.

Higher orders of n don't yield such compact solutions as the case where $n=0$. Equations

$$P_F(T+1) = (1-\beta) [b_{0,t} \phi_{0|t=-1} + \beta b_{1,t} \phi_{1|t=-1} + \beta^2 b_{2,t} \phi_{2|t=-1} + \dots + \beta^n b_{n,t} \phi_{n|t=-1}]$$

$$\text{Velocity} = (dP_F/dt)_{(T=-1)} = (1-\beta) [\beta b_{1,t} * (d\phi_1/dt)_{|t=-1} + \beta^2 b_{2,t} * (d\phi_2/dt)_{|t=-1} + \dots + \beta^n b_{n,t} * (d\phi_n/dt)_{|t=-1}]$$

The n^{th} Order Fading Memory Forecast Next Bar's Velocity System Defined

The least squares forecast is constructed by solving for the coefficients $b_0, b_1, b_2, \dots, b_n$ recursively at each bar using the last T bars of closing prices and the Discrete Orthogonal Meixner Polynomial equations above. Then **Velocity** = $dP_F(T+1)/dt$ is constructed from the velocity equation above and plotted under the price chart. In general what we will be doing is following the plotted curve of **Velocity** which is calculated at each bar from the previous T bars. When the velocity is greater than a threshold amount vup we will go long. When the velocity is less than a threshold amount $-vdown$ we will go short.

Buy Rule:

IF **Velocity** is greater than the threshold amount vup then buy at the market.

Sell Rule:

IF **Velocity** is less than the threshold amount $-vdown$ then sell at the market.

References

1. Morrison, Norman "Introduction to Sequential Smoothing and Prediction", McGraw-Hill Book Company, New York, 1969.

Appendix 2 -The Normalization Multiplier

What is the Multiplier ?

The n^{th} Order Fading Memory Polynomial, also called here an n^{th} Order Polynomial, is the least square fit of a polynomial of the form $P_F(T+1) = (1-\beta)[b_{0,t}\phi_{0|t=-1} + \beta b_{1,t}\phi_{1|t=-1} + \beta^2 b_{2,t}\phi_{2|t=-1} + \dots + \beta^n b_{n,t}\phi_{n|t=-1}]$ to a *Fading* number of past data points. Where t is discrete time bars. Time could be daily bars or one minute bars. We use the term "Fading Memory" because we weight the past data with a number that gets smaller and smaller the further back in time we go. It is assumed that the time bars occur at fixed intervals of time so tic bars would not be appropriate for this analysis. Suppose we want to find at some given time some n^{th} -degree polynomial that fits the data well at current and recent prices but ignores the fit as we move into the distant past. One way to construct this type of fit would be to weight the past data with a number that got smaller and smaller the further back in time we went. This type of error minimization is mathematically solvable and is widely used in science and mathematics. Once the b_n coefficients are found then the next bars estimate $(T+1)$ of the n^{th} order polynomial Acceleration and acceleration can be easily found by the equations below.

$$\text{Velocity} = (dP_F/dt)_{(T=-1)} = (1-\beta)[\beta b_{1,t} * (d\phi_1/dt)_{|t=-1} + \beta^2 b_{2,t} * (d\phi_2/dt)_{|t=-1} + \dots + \beta^n b_{n,t} * (d\phi_n/dt)_{|t=-1}]$$

$$0 < \beta < 1$$

Please see the *n^{th} Order Fading Memory Polynomial Next Bar's Forecast Math* section for a more detailed explanation.

For any tradable, the inputs to the polynomial are the **polynomial degree(aka Order)** and exponential decay constant β . When we plot the velocity we notice that the amplitude, and the maximum and minimum values of and standard deviation of the velocity vary quite significantly with different polynomial degree and β inputs.

Below is a table of the standard deviation of the 304156 calculated Velocity values for different **degree** and β inputs. The lookback period **N (number of bars of past data)** is approximately related to α ($\alpha=1-\beta$) by the formula $\alpha=2/(1+N)$. I use N because it gives a better understanding of how many bars of past data are approximately being used. We used 1 min bars of the E-Mini from 5/1/2012 to 5/1/2015 to generate this table.

ES 1 min bars Date Range 1120501 to 1150501

Total Number of Bars=304156 Norm=0

Trading Times Constraint Start Time=0 EndTime=0

FadmVn Multiplier to Scale Velocity pw and N Range to One Std

degree	N	Std	1/Std
1	20	0.095791	10.4394
1	30	0.078206	12.7867
1	40	0.0678338	14.7419
1	50	0.0607871	16.4509
1	60	0.0555952	17.9872
1	70	0.051562	19.3941
2	20	0.166382	6.01027
2	30	0.135156	7.39888
2	40	0.116914	8.55332
2	50	0.104594	9.56079
2	60	0.0955577	10.4649
2	70	0.0885688	11.2907
3	20	0.229464	4.35799
3	30	0.185563	5.38902
3	40	0.160108	6.2458

Appendix 2 -The Normalization Multiplier

3	50	0.143001	6.99297
3	60	0.13048	7.66398
3	70	0.120815	8.27714
4	20	0.288656	3.46433
4	30	0.232499	4.30109
4	40	0.200125	4.99688
4	50	0.178495	5.60241
4	60	0.162712	6.14583
4	70	0.150529	6.64324

The standard deviation varies from 0.06 to 0.28. The problem may get worse when we want to find good inputs for other tradables. Other tradables, because of their scales and tick size have much different Velocity ranges than the E-Mini for the same degree and N. Thus the search ranges have to be different for each different tradable, N and degree.

To solve this problem and to have a standard search space for each tradable, I created a **Mult** input for each FadmV Velocity strategy and indicator .. If each tradable's Velocity is multiplied by a number such that the standard deviation of that tradable's Velocity is close to one standard deviation then the search space for vup and vdn for each tradable would be 0 to 3 standard deviations and we wouldn't have to change the optimization search space every time we wanted to examine a new stock or future. The complicated equations that I use to normalize the ranges to one standard deviation for degree and N were derived using the software TableCurve 3D, automated surface and equation discovery. These equations are independent of the tradable and only depend on the polynomial degree and N. If you do not wish to use these equations then set iNorm=0. See note below .

How to Find The Mult.

Here is how to use the #FadmVMultStd. First load your chart with as much data as you are going to use. **Click on Insert-> Indicator.** Select the #FadmVMultStd. Modify the inputs to the indicator or just leave them at their default values. A table will be produced as shown below.

```
ES 1 min bars Date Range 1120501 to 1150501
Total Number of Bars=304156 Norm=1
Trading Times Constraint Start Time=0 EndTime=0
FadmVn Multiplier to Scale Velocity pw and N Range to One Std
```

pw	N	Std	1/Std	Std*Mult
1	20	0.351595	2.84418	0.988397
1	30	0.356036	2.80871	1.00088
1	40	0.360451	2.7743	1.01329
1	50	0.364442	2.74392	1.02451
1	60	0.368006	2.71735	1.03453
1	70	0.371198	2.69398	1.04351
		pw=1 Ave	2.76374	
2	20	0.34978	2.85894	0.983297
2	30	0.352419	2.83753	0.990715
2	40	0.355826	2.81036	1.00029
2	50	0.359166	2.78423	1.00968
2	60	0.362289	2.76023	1.01846
2	70	0.365198	2.73824	1.02664
		pw=2 Ave	2.79825	
3	20	0.348198	2.87193	0.978848
3	30	0.349252	2.86327	0.98181
3	40	0.351728	2.84311	0.98877

Appendix 2 -The Normalization Multiplier

3	50	0.354446	2.82131	0.996412
3	60	0.357074	2.80054	1.0038
3	70	0.359576	2.78105	1.01083
		pw=3 Ave	2.8302	
4	20	0.34757	2.87712	0.977083
4	30	0.347231	2.87993	0.97613
4	40	0.348855	2.86652	0.980694
4	50	0.351063	2.84849	0.986903
4	60	0.353331	2.83021	0.993277
4	70	0.3555	2.81294	0.999376
		pw=4 Ave	2.85253	
		Mult=	2.81118	

For each tradable chart:

1. Apply the **FadmVMultStd** indicator to your chart.
2. Find the Multiplier as shown above.
3. Record the multiplier value and delete the indicator from your chart.
4. **Apply that multiplier to the Mult input** with **iNorm=1** in the strategy.
5. Do the parameter search for vup & vdn in the default range 0.25 to 3 by 0.25 .

Added Note:

The complicated equations that I use to normalize the ranges to one standard deviation were derived using the software TableCurve 3D, automated surface and equation discovery. These equations are independent of the tradable and only depend on the polynomial degree and N. If you do not wish to use these equations then set inorm=0. Then when you run **FadmVMultStd** with **inorm =0** you will get a multiplier that gives an average of all the ranges. With iNorm=0 you will have to determine the vup -vdn ranges for your optimization. They will be different for different tradables and time bars. Below is the output for iNorm=0 for **FadmVMultStd**. As you can see the variation for degree(pw)=2 is 6 times the variation for degree=4. And the variation for n=70 is five times the variation for N=20. so for this example in order to cover all degree and N ranges at 3 standard deviations maximum you would have to go from vup/vdn from 0.0005 to 0.09. Of course the best solution for iNorm=0 would be to modify the strategy multiplier for each degree and N which is essentially what my equation does but not as exact.

ES 1 min bars Date Range 1120501 to 1150501
 Total Number of Bars=304156 Norm=0
 Trading Times Constraint Start Time=0 EndTime=0
 FadmVn Multiplier to Scale Velocity pw and N Range to One Std

pw	N	Std	1/Std	Std*Mult
2	20	0.00480974	207.912	1.82314
2	30	0.00259815	384.889	0.984833
2	40	0.00168332	594.062	0.638066
2	50	0.00120375	830.734	0.456284
2	60	0.000915983	1091.72	0.347204
2	70	0.000727482	1374.6	0.275753
		pw=2 Ave	747.321	
3	20	0.0139613	71.6267	5.29203
3	30	0.0075431	132.572	2.85922
3	40	0.00488588	204.671	1.852
3	50	0.00349297	286.289	1.32401
3	60	0.00265688	376.381	1.00709
3	70	0.00210918	474.118	0.799487
		pw=3 Ave	257.61	
4	20	0.0271776	36.795	10.3017
4	30	0.0146963	68.0445	5.57064
4	40	0.00951941	105.049	3.60834

Appendix 2 -The Normalization Multiplier

4	50	0.00680606	146.928	2.57984
4	60	0.00517708	193.159	1.96238
4	70	0.0041091	243.362	1.55756
		pw=4 Ave	132.223	
		Mult=	379.051	