

## The Noise Channel2 Breakout System

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In a previous article, we showed how the application of a simple channel breakout system, with a noise filter to minimize whipsaws due to random market trading noise, could be used to develop an intraday system to buy and sell IBM 5 minute bars. Here we will improve the previous Noise Channel System and apply it to IBM 5 minute bar data using the walk forward optimization technique discussed in our previous article. In order to compare the improvement to the Noise Channel system to our previous article we will use the same 5 minute bar prices of IBM from 2/21/2001 to 4/06/2001.

### More On Curve Fitting

This system as in the previous article will use a technique called out-of-sample testing. A non-random price series consists of a signal, the measurable part, and noise, the non repeating random part. It is impossible beforehand to tell what percentage of the collected price data consists of signal and what percentage consists of noise. After an optimization run on the test data, it is difficult to determine whether the input variables chosen from the optimization run have curve fit the noise which will not be repeated or have successfully modeled the price signal.

One point that many people don't realize is that it's almost impossible not to get a good curve fit with almost any indicator over some fixed time segment. If one looks at a curved fitted system's performance and it's associated buy and sell signals on a chart, the seemingly astounding results seem to leap off the page giving the *illusion* that future profits from the system will be forthcoming to those who use it. The various mathematical statistics that can be derived from the curve fitted system performance further intensify the illusion by generating statistical measures that validate the test data curve fit. Unfortunately these statistics do not tell how well the system will perform in the future. The excellent results produced by curve fitted systems only entice a potential user in a modern day "siren call" to believe in their repeatability. The reality is that future profits from curve fitted systems or anecdotal evidence are not assured and cannot be assumed. There is no way to tell if the input parameters chosen from an optimization run are curve fitting the noise which will not be repeated or the signal of the price series test data. The key to determine if a curve fitted system will work is to test it on data it has never been tested on, namely out-of-sample data, and observe how it performs on this data.

### The Noise Channel-2 Breakout System (NC2BS)

There are four system parameters to find for the NC2BS.

- **nhi** The number of bars in the lookback period used to determine the highest high price (hhp).
- **nlo**, The number of bars in the lookback period used to determine the lowest low price (llp).
- **xoU** The amount price must exceed the hhp to trigger a buy signal.
- **xoD** The amount price must fall below the llp to trigger a sell signal.

As can be seen, this system modifies the previous noise channel breakout system by adding different noise channels for the buy and sell signals. The theory for this modification is that it is assumed that the trading emotions associated with buy and sells are quite different. As such, the

lookback and the noise channels associated with buys and sells should be independent of each other.

The Noise Channel2 Breakout System is defined as follows:

**Buy Rule:**

If price crosses above the highest high price of the last *nhi* bars by an amount greater than or equal to *xoU*, **then** buy at the market. In addition, when short, and when calculating the highest high price (*hhp*), that *hhp* cannot be higher than the previously calculated *hhp* as the *nhi* lookback period moves forward and previous highs are dropped out of the lookback window. In other words when short the *hhp* can only stay the same or go lower...it cannot go higher.

**Sell Rule:**

If price crosses below the lowest low price of last *nlo* days minus by an amount of greater than or equal to *xoD*, **then** sell at the market. In addition, when long and when calculating the lowest low price (*llp*), that *llp* cannot be lower than the previous calculated *llp* as the *nlo* lookback period moves forward and previous lows are dropped out of the lookback window.

**Exit Rule**

Close any position 5 minutes before the New York Stock Exchange close (no trades will be carried overnight).

**Walk Forward Optimization**

As in the previous article walk forward optimization will be used here. The same data will be used as in our previous article so that we can judge whether this new modification can improve performance.

The walk forward procedure will be applied as follows. A period of 4 weeks from the start of the IBM 5 minute bar data, February 21<sup>st</sup>, 2001 through March 23<sup>rd</sup>, 2001, is chosen and system parameter values are found through optimization on this intraday data segment. The parameter values found are then applied to the out-of-sample 5 minute intraday bar data following the test segment which in this case is March 26<sup>th</sup>, 2001 to March 30<sup>th</sup>, 2001. This process is repeated by moving the test data window forward one week to February 28<sup>th</sup>, 2001 through March 30<sup>th</sup>, 2001, and again finding the parameters values through optimization on this new data test window. The parameter values found are then applied to the next out-of-sample 5 minute intraday bar data following this new test window data which in this case is April 2<sup>nd</sup>, 2001 to April 6<sup>th</sup>, 2001.

**Finding The System Parameters Using Walk Forward Optimization**

There are four system parameters to find *nhi*, *nlo*, *xoU*, and *XoD*. The best parameters will be defined as those values that give the best Net Profits and best Total winning Bars to Total Losing Bars ratio with the minimum drawdown and minimum largest losing trades. In addition, the results should be stable, e.g. the profits, wins, and drawdowns should not change by much as the parameters move by a small amount away from their optimum values. Also in choosing the “best” parameters, we considered only those parameters sets whose maximum consecutive losses were 4 or less. Optimization is defined as the search for the parameter values that give the best results as defined above. It should be noted that in this stage of system development, the only

thing indicated by the optimum values that are found in the test portion is that the data has been *curve fitted* as best it can with this system. Without further testing on out-of-sample data there is no way to tell if the system will work in the future.

## Results

Figure 1 presents a table of the test window selected optimum parameters for the IBM 5min data series.

Start Date	End Date	nhi	xoU	nlo	xoD
02/21/01	03/23/01	8	1	4	1
02/28/01	03/30/01	18	1.25	12	0.25

**Figure 1 Optimum Parameter Values For Test Data Segments**

Figures 2a and 2b presents the performance summary of the test windows using the optimum parameters for the test windows shown in Figure 1.

Figure 3a presents the combined performance summary of the two out-of-sample data segment from 3/26/01 to 4/06/01. This performance represents what would have happened in *real time* if one used the parameters found in the test sections. Slippage, and commissions are not included.

For comparison's sake we include Figure 3b. Figure 3b presents the combined performance summary of the two out-of-sample data segment from 3/26/01 to 4/06/01 for the Noise Channel System from our previous article.

Figure 4 presents a specialized percentage trade by trade summary from 3/26/01 to 4/06/01. Note that the trades from 3/26/01 to 4/06/01 are the out-of-sample trades generated from the optimized parameters from the two test sections of 2/21/01 to 3/23/01 and 2/28/01 to 3/30/01. The in sample trades were generated by the curve fit and are not of interest here.

In addition, for comparison with Figure 4, Figure 5 presents the specialized trade by trade summary from our previous system for the same out-of-sample dates.

Figures 6A through 6D present the 5 minute bar charts of IBM with the Noise Channel 2 superimposed and all the buy and sell signals from the trade by trade summary of Figure 4 indicated on the charts. Also included at the bottom of the charts are the bar by bar profit or loss of each trade. The lower plot tracks the runup and drawdown of each trade.

## Discussion of System Performance

In looking at the optimum parameters in Figure 1 we can see that the first test data section produced the exact same optimum parameters as the original Noise Channel system. This can be seen by observing that both **xoU** and **xoD** are exactly the same and are equal to **f** of the Noise Channel System.

As can be observed from the test sample Performance summary in Figures 2a, 2b and the out-of-sample performance summary of Figure 3a, the out-of-sample performance was better than the test sample performance with respect to average winning and losing trades, drawdowns and profit factor. This better performance in the out-of-sample section could have been due to chance but does indicate that 4 weeks of test data was enough to capture the intraday price dynamics of IBM.

Comparing Figures 3a and 3b, we can see from these performance summaries that there is very little difference between the Noise Channel System and the Noise Channel 2 System. The less complicated Noise Channel System while having a slightly lower net profit and avg win/ avg loss ratio, has a smaller drawdown and a smaller Largest Losing Trade. In comparing Figures 3a and 3b we would favor the less complicated Noise Channel System.

Observing the out-of-sample trade by trade summary of Figure 4, we can see that the system did better on short trades than it did on long trades. This could indicate a negative bias for the system or perhaps given the current Bear Market environment this could be normal. Whatever the reason this bias warrants further investigation. There were no big winners or big losers indicating steady returns. Average wins were 2.6 times average losses in the out-of-sample section. Average trade runups were \$1493, average trade drawdowns were -\$948 and the average trade net profit was \$576.

It's instructive to compare Figure 4 with Figure 5 from the Noise Channel System in our previous article. We wish to determine if the more complicated Noise Channel 2 System offers any advantage in the trade by trade figures.

In comparing Figures 4 and 5, we can see that the added complication of the Noise Channel 2 System offers little advantage in performance. Both systems totals and averages are very nearly the same. The Noise Channel 2 system had 1 less trade and slightly better numbers. However the difference wasn't enough, in our opinion, to claim any superiority or to justify the added complication of another optimization parameter.

As in the previous system we can see that the Noise Channel 2 System did very well in catching every major intraday trend of IBM. As can be seen from the charts, the system constraint of not carrying positions overnight eliminated many negative opening surprises. Overall the Noise Channel 2 system did a good job in minimizing the losses due to the inevitable whipsaws that will occur in any trading system and maximizing the profits from the major intraday trend moves of IBM.

In order to use this system in real time trading, at least ten to twenty more test and out-of-sample windows would have to be examined to make sure that the above results above were not due to pure chance.

### **References:**

Meyers, Dennis [2001], "The Noise Channel System", *Active Trader Magazine*, September 2001.

### **Info on Dennis Meyers**

Dennis Meyers ([info@MeyersAnalytics.com](mailto:info@MeyersAnalytics.com)) has a doctorate in applied mathematics in engineering. He is a private trader, and president of Meyers Analytics ([www.MeyersAnalytics.com](http://www.MeyersAnalytics.com)). His firm specializes in Financial Engineering consulting for financial institutions and developing publicly available analytical software for traders.

**Figure 2a Test Window Performance Summary for IBM Noise Channel 2 System IBM-5 min bars  
02/21/2001 - 03/23/2001**

Noise Channel 2 System IBM 5 min bars 02/21/2001 - 03/23/2001  
Performance Statistics based upon Buying and Selling 1000 shares of IBM

Performance Summary: All Trades

Total net profit	\$ 13890.000	Open position P/L	\$ 0.000
Gross profit	\$ 39260.000	Gross loss	\$-25370.000
Total # of trades	48	Percent profitable	54%
Number winning trades	26	Number losing trades	22
Largest winning trade	\$ 5940.000	Largest losing trade	\$ -2060.000
Average winning trade	\$ 1510.000	Average losing trade	\$ -1153.182
Ratio avg win/avg loss	1.309	Avg trade(win & loss)	\$ 289.375
Max consec. winners	4	Max consec. losers	3
Avg # bars in winners	39	Avg # bars in losers	21
Max intraday drawdown	\$ -8470.000		
Profit factor	1.547	Max # contracts held	1

Performance Summary: Long Trades

Total net profit	\$ 230.000	Open position P/L	\$ 0.000
Gross profit	\$ 13770.000	Gross loss	\$-13540.000
Total # of trades	23	Percent profitable	43%
Number winning trades	10	Number losing trades	13
Largest winning trade	\$ 5940.000	Largest losing trade	\$ -2060.000
Average winning trade	\$ 1377.000	Average losing trade	\$ -1041.538
Ratio avg win/avg loss	1.322	Avg trade(win & loss)	\$ 10.000
Max consec. winners	3	Max consec. losers	5
Avg # bars in winners	32	Avg # bars in losers	15
Max intraday drawdown	\$-10780.000		
Profit factor	1.017	Max # contracts held	1

Performance Summary: Short Trades

Total net profit	\$ 13660.000	Open position P/L	\$ 0.000
Gross profit	\$ 25490.000	Gross loss	\$-11830.000
Total # of trades	25	Percent profitable	64%
Number winning trades	16	Number losing trades	9
Largest winning trade	\$ 4320.000	Largest losing trade	\$ -1840.000
Average winning trade	\$ 1593.125	Average losing trade	\$ -1314.444
Ratio avg win/avg loss	1.212	Avg trade(win & loss)	\$ 546.400
Max consec. winners	5	Max consec. losers	3
Avg # bars in winners	43	Avg # bars in losers	28
Max intraday drawdown	\$ -5080.000		
Profit factor	2.155	Max # contracts held	1

**Figure 2b Test Window Performance Summary for IBM Noise Channel 2 System IBM-5 min bars  
02/28/2001 - 03/30/2001**

Noise Channel 2 System IBM 5 min bars 02/28/2001 - 03/30/2001  
Performance Statistics based upon Buying and Selling 1000 shares of IBM

Performance Summary: All Trades

Total Net Profit	\$9,640.00	Open position P/L	\$0.00
Gross Profit	\$34,460.00	Gross Loss	(\$24,820.00)
Total # of trades	38	Percent profitable	52.63%
Number winning trades	20	Number losing trades	18
Largest winning trade	\$5,350.00	Largest losing trade	(\$3,400.00)
Average winning trade	\$1,723.00	Average losing trade	(\$1,378.89)
Ratio avg win/avg loss	1.25	Avg trade (win & loss)	\$253.68
Max consec. Winners	3	Max consec. losers	2
Avg # bars in winners	48	Avg # bars in losers	28
Max intraday drawdown	(\$10,030.00)		
Profit Factor	1.39	Max # contracts held	1

Performance Summary: Long Trades

Total Net Profit	\$2,680.00	Open position P/L	\$0.00
Gross Profit	\$10,920.00	Gross Loss	(\$8,240.00)
Total # of trades	15	Percent profitable	40.00%
Number winning trades	6	Number losing trades	9
Largest winning trade	\$5,350.00	Largest losing trade	(\$1,790.00)
Average winning trade	\$1,820.00	Average losing trade	(\$915.56)
Ratio avg win/avg loss	1.99	Avg trade (win & loss)	\$178.67
Max consec. Winners	2	Max consec. losers	3
Avg # bars in winners	31	Avg # bars in losers	14
Max intraday drawdown	(\$6,410.00)		
Profit Factor	1.33	Max # contracts held	1

Performance Summary: Short Trades

Total Net Profit	\$6,960.00	Open position P/L	\$0.00
Gross Profit	\$23,540.00	Gross Loss	(\$16,580.00)
Total # of trades	23	Percent profitable	60.87%
Number winning trades	14	Number losing trades	9
Largest winning trade	\$4,620.00	Largest losing trade	(\$3,400.00)
Average winning trade	\$1,681.43	Average losing trade	(\$1,842.22)
Ratio avg win/avg loss	.91	Avg trade (win & loss)	\$302.61
Max consec. Winners	4	Max consec. losers	3
Avg # bars in winners	56	Avg # bars in losers	42
Max intraday drawdown	(\$7,540.00)		
Profit Factor	1.42	Max # contracts held	1

### Figure 3a Combined Walk Forward Out-Of-Sample Performance Summary for IBM Noise Channel System IBM-5 min bars 03/26/2001 - 04/06/2001

Noise Channel System IBM 5 min bars Combined Out-Of-Sample 03/26/2001 - 04/06/2001  
Performance Statistics based upon Buying and Selling 1000 shares of IBM

#### Performance Summary: All Trades

Total Net Profit	8650.00	Open position P/L	0.00
Gross Profit	15390.00	Gross Loss	-6740.00
Total # of trades	15.00	Percent profitable	0.47
Number winning trades	7.00	Number losing trades	8.00
Largest winning trade	4000.00	Largest losing trade	-1730.00
Average winning trade	2198.57	Average losing trade	-842.50
Ratio avg win/avg los	2.61	Avg trade (win & los)	576.67
Max consec. Winners	2.00	Max consec. losers	3.00
Avg # bars in winners	57.00	Avg # bars in losers	38.00
Max intraday drawdown	-5660.00		
Profit Factor	2.28	Max # contracts held	1.00

#### Performance Summary: Long Trades

Total Net Profit	2650.00	Open position P/L	0.00
Gross Profit	6470.00	Gross Loss	-3820.00
Total # of trades	6.00	Percent profitable	0.33
Number winning trades	2.00	Number losing trades	4.00
Largest winning trade	4000.00	Largest losing trade	-1730.00
Average winning trade	3235.00	Average losing trade	-955.00
Ratio avg win/avg los	3.39	Avg trade (win & los)	441.67
Max consec. Winners	1.00	Max consec. losers	3.00
Avg # bars in winners	72.00	Avg # bars in losers	33.00
Max intraday drawdown	-2700.00		
Profit Factor	1.69	Max # contracts held	1.00

#### Performance Summary: Short Trades

Total Net Profit	6000.00	Open position P/L	0.00
Gross Profit	8920.00	Gross Loss	-2920.00
Total # of trades	9.00	Percent profitable	0.56
Number winning trades	5.00	Number losing trades	4.00
Largest winning trade	3420.00	Largest losing trade	-1450.00
Average winning trade	1784.00	Average losing trade	-730.00
Ratio avg win/avg los	2.44	Avg trade (win & los)	666.67
Max consec. Winners	3.00	Max consec. losers	2.00
Avg # bars in winners	51.00	Avg # bars in losers	42.00
Max intraday drawdown	-3930.00		
Profit Factor	3.05	Max # contracts held	1.00

**Figure 3b Combined Walk Forward Out-Of-Sample Performance Summary for IBM Noise Channel System IBM-5 min bars 03/26/2001 - 04/06/2001**

Noise Channel System IBM 5 min bars Combined Out-Of-Sample 03/26/2001 - 04/06/2001  
 Performance Statistics based upon Buying and Selling 1000 shares of IBM

**Performance Summary: All Trades**

Total net profit	\$ 8390.000	Open position P/L	\$ 0.000
Gross profit	\$ 14460.000	Gross loss	\$ -6070.000
Total # of trades	16	Percent profitable	50%
Number winning trades	8	Number losing trades	8
Largest winning trade	\$ 4000.000	Largest losing trade	\$ -1350.000
Average winning trade	\$ 1807.500	Average losing trade	\$ -758.750
Ratio avg win/avg loss	2.382	Avg trade(win & loss)	\$ 524.375
Max consec. winners	5	Max consec. losers	3
Avg # bars in winners	54	Avg # bars in losers	37
Max intraday drawdown	\$ -4480.000		
Profit factor	2.382	Max # contracts held	1

**Performance Summary: Long Trades**

Total net profit	\$ 2530.000	Open position P/L	\$ 0.000
Gross profit	\$ 6470.000	Gross loss	\$ -3940.000
Total # of trades	7	Percent profitable	43%
Number winning trades	3	Number losing trades	4
Largest winning trade	\$ 4000.000	Largest losing trade	\$ -1350.000
Average winning trade	\$ 2156.667	Average losing trade	\$ -985.000
Ratio avg win/avg loss	2.190	Avg trade(win & loss)	\$ 361.429
Max consec. winners	2	Max consec. losers	3
Avg # bars in winners	64	Avg # bars in losers	31
Max intraday drawdown	\$ -4930.000		
Profit factor	1.642	Max # contracts held	1

**Performance Summary: Short Trades**

Total net profit	\$ 5860.000	Open position P/L	\$ 0.000
Gross profit	\$ 7990.000	Gross loss	\$ -2130.000
Total # of trades	9	Percent profitable	56%
Number winning trades	5	Number losing trades	4
Largest winning trade	\$ 3420.000	Largest losing trade	\$ -940.000
Average winning trade	\$ 1598.000	Average losing trade	\$ -532.500
Ratio avg win/avg loss	3.001	Avg trade(win & loss)	\$ 651.111
Max consec. winners	3	Max consec. losers	2
Avg # bars in winners	48	Avg # bars in losers	42
Max intraday drawdown	\$ -3140.000		
Profit factor	3.751	Max # contracts held	1

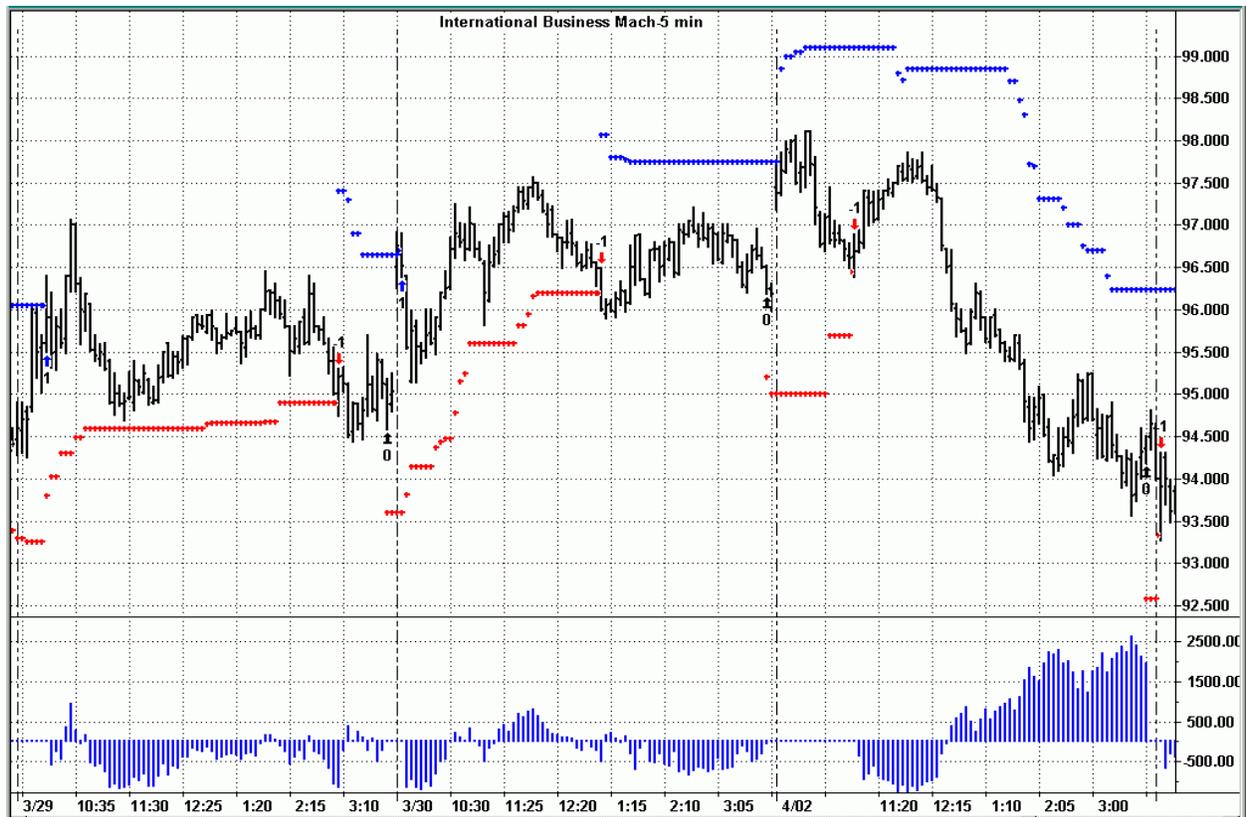
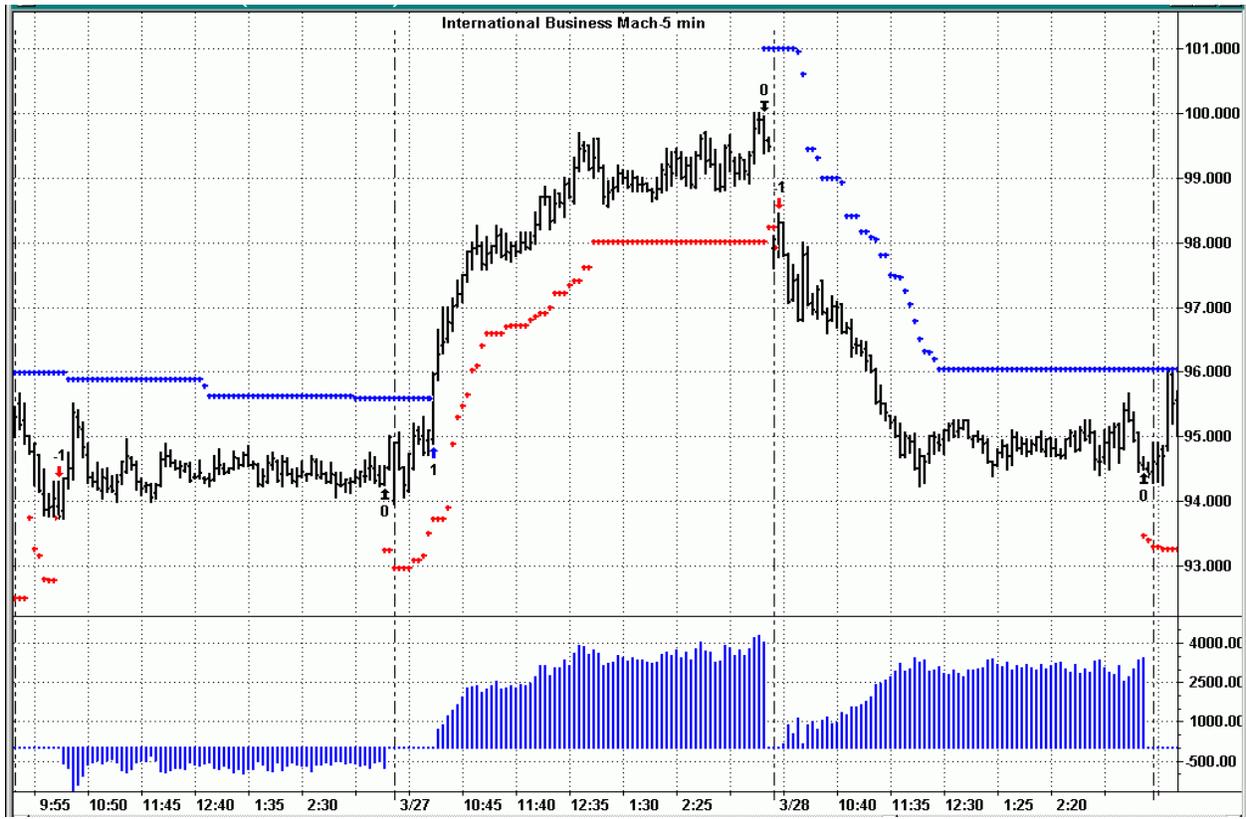
**FIGURE 4 Out-Of-Sample Trade By Trade Summary**  
**IBM 5min Noise Channel 2 System Trade Size = 1000 Shares 03/26/2001 to 04/06/2001**

Entry Date	Entry Time		Entry Price	Exit Date	Exit Time	Exit Price	Bars InTrd	Trade \$P&L	Trade %P&L	Trade Max\$Pft	Time	Trade Max\$DD	Time
3/26/01	1020	Sell	93.75	3/26/01	1555	94.52	67	(770)	-0.82%	0	1020	(1,620)	1035
3/27/01	1015	Buy	95.59	3/27/01	1555	99.59	68	4,000	4.18%	4,300	1550	0	1015
3/28/01	940	Sell	97.92	3/28/01	1555	94.50	75	3,420	3.49%	3,420	1200	(380)	940
3/29/01	1005	Buy	96.05	3/29/01	1505	94.90	60	(1,150)	-1.20%	950	1030	(1,160)	1120
3/29/01	1505	Sell	94.90	3/29/01	1555	94.88	10	20	0.02%	390	1515	(500)	1545
3/30/01	940	Buy	96.70	3/30/01	1305	96.20	41	(500)	-0.52%	800	1155	(1,190)	1000
3/30/01	1305	Sell	96.20	3/30/01	1555	96.25	34	(50)	-0.05%	220	1315	(840)	1435
4/2/01	1055	Sell	96.45	4/2/01	1555	94.50	60	1,950	2.02%	2,650	1540	(1,250)	1140
4/3/01	940	Sell	93.33	4/3/01	1555	90.50	75	2,830	3.03%	3,070	1540	(670)	945
4/4/01	1055	Buy	92.99	4/4/01	1255	92.55	24	(440)	-0.47%	910	1120	(660)	1100
4/4/01	1255	Sell	92.55	4/4/01	1555	91.85	36	700	0.76%	930	1400	(520)	1320
4/5/01	940	Buy	95.68	4/5/01	1555	98.15	75	2,470	2.58%	3,040	1525	(10)	940
4/6/01	940	Sell	97.30	4/6/01	1200	98.75	28	(1,450)	-1.49%	550	1115	(1,450)	1200
4/6/01	1200	Buy	98.75	4/6/01	1235	97.02	7	(1,730)	-1.75%	1,150	1205	(1,730)	1235
4/6/01	1235	Sell	97.02	4/6/01	1555	97.67	40	(650)	-0.67%	20	1235	(2,240)	1355
								<b>Total</b>	<b>Average</b>	<b>Average</b>		<b>Average</b>	
								8650	0.61%	1493		(948)	

**FIGURE 5 Out-Of-Sample Trade By Trade Summary**  
**IBM 5min Noise Channel System Trade Size = 1000 Shares 03/26/2001 to 04/06/2001**

Entry Date	Entry Time		Entry Price	Exit Date	Exit Time	Exit Price	Bars InTrd	Trade \$P&L	Trade %P&L	Trade Max\$Pft	Time	Trade Max\$DD	Time
03/26/01	1020	Sell	93.75	03/26/01	1555	94.52	67	(770)	-0.82%	0	1020	(1,620)	1035
03/27/01	1015	Buy	95.59	03/27/01	1555	99.59	68	4,000	4.18%	4,300	1550	0	1015
03/28/01	940	Sell	97.92	03/28/01	1555	94.50	75	3,420	3.49%	3,420	1200	(380)	940
03/29/01	1005	Buy	96.05	03/29/01	1505	94.90	60	(1,150)	-1.20%	950	1030	(1,160)	1120
03/29/01	1505	Sell	94.90	03/29/01	1555	94.88	10	20	0.02%	390	1515	(500)	1545
03/30/01	940	Buy	96.70	03/30/01	1305	96.20	41	(500)	-0.52%	800	1155	(1,190)	1000
03/30/01	1305	Sell	96.20	03/30/01	1555	96.25	34	(50)	-0.05%	220	1315	(840)	1435
04/02/01	940	Buy	97.75	04/02/01	1055	96.40	15	(1,350)	-1.38%	350	1005	(1,350)	1055
04/02/01	1055	Sell	96.40	04/02/01	1555	94.50	60	1,900	1.97%	2,600	1540	(1,300)	1140
04/03/01	1000	Sell	93.00	04/03/01	1555	90.50	71	2,500	2.69%	2,740	1540	0	1000
04/04/01	945	Buy	92.00	04/04/01	1350	92.00	49	0	0.00%	1,900	1120	(1,890)	1030
04/04/01	1350	Sell	92.00	04/04/01	1555	91.85	25	150	0.16%	380	1400	(500)	1420
04/05/01	940	Buy	95.68	04/05/01	1555	98.15	75	2,470	2.58%	3,040	1525	(10)	940
04/06/01	940	Sell	97.30	04/06/01	1155	98.24	27	(940)	-0.97%	550	1115	(940)	1155
04/06/01	1155	Buy	98.24	04/06/01	1235	97.30	8	(940)	-0.96%	1,660	1205	(940)	1235
04/06/01	1235	Sell	97.30	04/06/01	1555	97.67	40	(370)	-0.38%	300	1235	(1,960)	1355
								<b>Total</b>	<b>Average</b>	<b>Average</b>		<b>Average</b>	
								8390	0.55%	1475		(911)	

**FIGURE 6 IBM 5min Noise Channel System Chart  
Out-Of-Sample 03/26/2001 to 04/06/2001**



**FIGURE 6 IBM 5min Noise Channel System Chart  
Out-Of-Sample 03/26/2001 to 04/06/2001**

