IBM Cubed
Copyright © 1999 Dennis Meyers, Ph.D.

In a previous article on the British Pound(BP), we showed how the application of a curve generated by a third degree polynomial could be used to develop a system to buy and sell British Pound futures.. . Here we will use a variation of that previously developed British Pound Cubed system to create a system to trade IBM.

IBM is one of the premier computer corporations in the world and is a major factor in the movement of the Dow Jones and S&P 500 indices. Although IBM is traded on all regional exchanges the lion's share and real market of IBM is traded on the NYSE.

Data Discussion
Here we will use the daily prices of IBM from 1/1/93 to 12/31/98. IBM pays dividends on a quarterly basis, usually on the dividend payable dates of March 10th, June 10th, September 10th , and December 10th. On the Ex dates when IBM pays it's dividend the price of the stock is adjusted down by the value of the dividend. Thus over a year IBM has a small downward bias in price by the amount of the yearly dividend. If you were a holder of IBM then you would receive those dividends in cash and the small downward bias over the year would be made up be the cash dividends you received. However in developing a system using IBM prices, those prices are not adjusted for the dividend payments. This non-dividend adjustment creates a small distortion in parameter selection and walk forward results.

The Least Squares Quadratic-Cubic System.
In a previous article, entitled "Surfing The Linear Regression Curve" I used the technique of least Squares to fit a straight line through 30+ closing prices to create a curve that served as a proxy for the market trend. When the curve moved up by a certain percent from its previous local low, the trend was assumed to have changed to the upside and a buy signal was given. When the curve moved down by a certain percent from its previous local high, the trend was assumed to have changed to the downside and a sell signal was given. Here I will use the least squares technique to fit a either a quadratic polynomial of the form $a_0 + b_0*t + c_0*t^2$ or a cubic polynomial of the form $a_0+b_0*t+c_0*t^2 +d_0*t^3$ to create a curve that will serve as a better proxy for the market trend. The quadratic and cubic polynomials should respond faster to changes in the underlying trend and model the trend changes more accuracy than the straight line version . We will let the computer determine via optimization whether the quadratic or the cubic polynomials better represent the underlying trend on IBM

What is Least Squares?
Least squares is a mathematical technique where the squared vertical distance between the data and the curve that is being fit to the data is minimized. When the net squared distance (also called the sum of the squared errors) is minimized, a unique set of coefficients a_0,b_0,c_0, and d_0 for the polynomial is determined.

For the cubic equation, the least squares coefficients are obtained from the solution of the following matrix equation.

$$
\begin{vmatrix} T & \Sigma t & \Sigma t^2 & \Sigma t^3 \\ \Sigma t & \Sigma t^2 & \Sigma t^3 & \Sigma t^4 \\ \Sigma t^2 & \Sigma t^3 & \Sigma t^4 & \Sigma t^5 \\ \Sigma t^3 & \Sigma t^4 & \Sigma t^5 & \Sigma t^6 \end{vmatrix} \begin{vmatrix} a_0 \\ b_0 \\ c_0 \\ d_0 \end{vmatrix} = \begin{vmatrix} \Sigma p(t) \\ \Sigma(p(t)*t) \\ \Sigma(p(t)*t^2) \\ \Sigma(p(t)*t^3) \end{vmatrix}
$$

and for the quadratic equation, the least squares coefficients are obtained from the solution of the following matrix equation.

$$
\begin{vmatrix} T & \Sigma t & \Sigma t^2 \\ \Sigma t & \Sigma t^2 & \Sigma t^3 \\ \Sigma t^2 & \Sigma t^3 & \Sigma t^4 \end{vmatrix} \begin{vmatrix} a_0 \\ b_0 \\ c_0 \end{vmatrix} = \begin{vmatrix} \Sigma p(t) \\ \Sigma(p(t)*t) \\ \Sigma(p(t)*t^2) \end{vmatrix}
$$

where

p(T) is today's price, **p(T-1)** is yesterdays price and **p(1)** is the price **T** days ago.

$\Sigma\mathbf{p(t)}$ is the summation of prices from **t=1 to T** days
$\Sigma\mathbf{p(t)*t}$ is the summation of prices times t from **t=1 to T** days
$\Sigma\mathbf{t}$ is the summation of the integer t from **t=1 to T** days
$\Sigma\mathbf{t^2}$ is the summation of the integer t squared from **t=1 to T** days
etc.

Programs that solve for the solution to matrix equations can be found in the book "Numerical Recipes" by W. Press, et. al. which is currently available in book stores. The programs in this book can be translated into TradeStation's Easylanguage™.

Once the coefficients to the polynomial have been solved for we generate the forecast for the next day's price which is given for the cubic equation by:

$$P_f = a0 + b0*(T+1) + c0*(T+1)^2 + d0*(T+1)^3$$

and for the quadratic equation by:

$$P_f = a0 + b0*(T+1) + c0*(T+1)^2$$

Where $\mathbf{P_f}$ stands for price forecast.

We use the next day forecast price because changes in the trend are more quickly reflected in the forecast price than in the end point price.

The Least Squares Quadratic-Cubic System Defined
The least squares forecast is constructed by solving for the least squares coefficients each day using the last T days of "average prices. The average daily price is constructed by taking the average of the daily high and low. P_f is then constructed from the equation above and plotted under the price chart. In general what we will be doing is following the plotted curve of P_f. When the curve increases by a percentage amount *pctup* from the previous prior low of the curve we will go long. When the curve falls by the percentage amount *pctdn* from the previous prior high of the curve we will go short.

Buy Rule:
- **IF P_f** has moved up by more than the percentage amount of *pctup* from the lowest low recorded in P_f while short and today's average price is greater than yesterday's P_f, then buy IBM at tomorrows open.

Sell Rule:
- **IF P_f** has moved down by more than the percentage amount *pctdn* from the highest high recorded in P_f while long and today's average price is less than yesterday's P_f, then sell IBM at tomorrows open.

Walk Forward Optimization
Walk forward optimization will be used here because of the changing nature of markets for individual stocks.. IBM is a major US Corporation that is constantly changing and redefining itself as worldwide Compton challenges IBM's areas of dominance. The US and World economies also have a direct effect on IBM's profitability. As such, conditions that prevailed 3 years ago may no longer be representative of today's relationship.

The walk forward procedure will be applied as follows. A period of 3 years from the start of the data, January 1, 1993 through December 31, 1995, is chosen and system parameter values are found through optimization on this daily data segment. The parameter values found are then applied to the out-of-sample data in the year following the test segment which in this case is year 1996. The out-of-sample results are then tabulated and saved for year 1996.

Next, the data testing window is now moved forward one year to January 1, 1994 through December 31 1996, and new optimum parameter values are found. The new optimum parameters are applied to the out-of-sample year 1997 and the out-of-sample results are tabulated for year 1997. etc.

The moving data test window walks forward one year at a time creating optimum values for each 3 year window data segment. The optimum parameters derived from these windows are applied to the year outside the test data window. At the end, all tabulated one year out-of-sample results are merged to create one big out-of-sample results segment. The theory behind this computationally intensive method is that price dynamics available for modeling and finding parameters will change slowly over time. It is assumed that enough data is available to predict a

short time into the future before things change and the model falls apart. It takes time for events and technology to change things, so it is *assumed* that using the optimum values based upon the previous three years will be adequate to use in the year forward.

Why 3 year data segments? Why not 5 years or 1 year? Well the answer is that there is no correct ratio of test data needed to produce good one year out-of-sample results. By experimenting with different window lengths, the three to one ratio seemed to work well. In walk forward testing enough data is needed to model most of the price dynamics that will be encountered in the out-of-sample segment, but not so much data that when the price dynamics start to change they are swamped by the weight of distant past data price dynamics that no longer are valid. An important unspoken point in walk forward testing is that if you can not get good results in the out-of-sample segments, then the price dynamics cannot be modeled with the system . This means that real time performance will be random using the model. Traders observe this type of random performance (that is it looks great on paper but falls apart in real time) when trying systems based on curve fitting or anecdotal "proof" (looking at 3 or 4 successful cases only) without any out-of-sample testing .

Finding The System Parameters Using Walk Forward Optimization
There are four system parameters to find *Polynomial Power*(*powr*),*T*, *pctup, and pctdn*. The best parameters will be defined as those values that give the best Net Profits with the highest percentage of wins, 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, I considered only those parameters sets whose maximum consecutive losses were 3 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.

As explained above, the walk forward testing will be done on moving 3 year data windows. Those data windows are:

Test Data Window 1. 1/1/93 to 12/31/95
Test Data Window 2. 1/1/94 to 12/31/96
Test Data Window 3. 1/1/95 to 12/31/97

An Aside: How To Lie and Befuddle With Statistics
Some market pundits make the absurd and unproven claim that statistics generated from the optimized buy and sell trades in the test section have value in predicting whether or not the system will perform well in the future. Nothing could be farther from the truth! The only thing the statistics from the test section tell you is how well you have curve fitted the data in the test section. In our Least square polynomial fit process the error minimization forces the generated curve to fit the past data like a glove. As a matter of fact it's almost impossible not to get an excellent fit with excellent statistical results. It is not well known, but almost any system can fit

almost any random series that is defined over a fixed number of bars very well via the optimization procedure. I can assure you that the statistics of this curve fit, "will look marvelous" giving the illusion of future profitability. As we all know random process price dynamics are not going to repeat themselves outside the test segment no matter how good the statistics are in the fixed time test section.

Results
Figure 1 presents a table of the 3 window data segments and their corresponding optimum parameter values. As we can see from Figure 1, the computer picked the cubic polynomial as best in all three test windows. This selection is due to the ability of the cubic polynomial to model more complicated price "wiggles" than the quadratic polynomial. Most of the parameter values do not change much from test segment to test segment verifying that three years is enough data to produce parameter values that are stable over the next out of sample year and that capture most of the price dynamics. However, in later reviewing the test segment optimization printouts of each window, it became clear that for a real time applications the optimization should be done a minimum of every six months.

Figures 2 through 4 present the performance summary using the derived optimum values for the three data window test segments shown in Figure 1.

Figure 5 presents the performance summary of the merged out-of-sample one year data segments from 1/1/96 to 12/31/98. This performance represents what would have happened in *real time* if one followed the walk forward testing procedure. Slippage, commissions not included.

Figure 6 presents a comparison performance summary table for each of the 3 time segments. This table also presents the best optimized one year performance and the out-of-sample performance for that same year produced from the optimized parameters of the previous 3 year time segment.

Figure 7 presents a specialized percentage trade by trade summary from 1/1/93 to 12/31//98. Note that the trades from 1/1/93 to 12/31/95 are generated from the optimized parameters from that period but the trades from 1/1/96 to 12/31/98 are from the merged out-of-sample one year data segments.

Figure 8 presents a specialized trade by trade Risk/Reward summary for the test and out-of-sample sections from 1/1/93 to 12/31/98.

Figure 9 presents a specialized the trade by trade Risk/Reward summary for the out-of-sample trades only from 1/1/95 to 12/31/98.

Figures 10A through 10G present the charts of IBM with the Least Squares Quadratic-Cubic system and all the buy and sell signals from the trade by trade summary of Figure 7 indicated on the charts. Each buy trade and sell trade *percent* drawdown and *percent* gain is plotted along the bottom of the charts.

Discussion of System Performance
As can be observed from the test sample Performance summaries in Figures 2 through 4, the percent profitable trades and dollar drawdowns get larger as the test windows move toward the current date. This is because the average price of IBM increased from 25 in 1993 to 130 in 1998. Bigger price magnitudes generate bigger dollar denominated performance results. Since the Buy and Sell signals were based upon percentage changes of the polynomial curve, the parameters should not be affected by IBM's price magnitude change.

Figure 7 presents the trade by trade results on a *percentage* basis. As we can see from the Trade Maximum % Drawdown and Maximum % profit or runup columns, the out-of-sample portion gave a better performance percentage-wise than the test section.

Observing the out-of-sample trade risk/reward summary of Figure 9, we can see that the system that was long during system buys and in cash during system sells beat buy and hold by a 2%/yr margin. Being that the system was only long 53% of the time these results are excellent. The Buy and Short results performed slightly worse than Buy and Hold. However, since we were are in one of the biggest bull markets in our history these results are also good. We won't be in a bull market forever, and the ability to cash in on the short side will be of value.

In observing the charts we can see that the system did very well in catching every major trend of IBM. The system sold too early in 1997, but avoided the October 1997 decline. In 1998, the system did an excellent job of avoiding the August 1998 decline but bought back in after the first bottom and had to suffer a loss when the second higher bottom of the bear market was made. However the system bought right back in after the second bottom and participated fully in stock markets latest big bull market.

References:
Meyers, Dennis [1998], "The British Pound, Cubed", *Stocks & Commodities*, Volume 16: November.

Meyers, Dennis [1998], "Surfing The Linear Regression Curve", *Stocks & Commodities*, Volume 16: May.

Press, William H., et al, "Numerical Receipts in C: the Art of Scientific Computing", Cambridge Press, 1993.

Info on Dennis Meyers
Dennis Meyers has a doctorate in applied mathematics in engineering. He is a member of the Chicago Board Options Exchange(CBOE), a private trader, and president of Meyers Analytics. His firm specializes in consulting for financial institutions and developing publicly available analytical software for traders. He can be reached (312) 280-1687, via his Web site at http://www.MeyersAnalytics.com or via E-mail at meyersx@MeyersAnalytics.com.

Figure 1 Optimum Parameter Values For Each Walk Forward Data Segment

Start Date	End Date	Powr	T	Pctup	Pctdn
1/1/93	12/31/95	3	34	10.5%	10.5%
1/1/94	12/31/96	3	34	10.0%	10.5%
1/1/95	12/31/97	3	34	6.5%	5.0%

IBM Cubed

Figure 2 Test Window Performance Summary for IBM LSqrNthPwr System 01/04/93-12/31/95

```
LSqr NthPowerPoly  IBM.-Daily   01/04/93 - 12/29/95

         Performance Summary:  All Trades

Total net profit      $  2974.000   Open position P/L    $      0.000
Gross profit          $  3367.000   Gross loss           $   -393.000

Total # of trades            7      Percent profitable          57%
Number winning trades        4      Number losing trades         3

Largest winning trade $  2087.000   Largest losing trade $   -219.000
Average winning trade $   841.750   Average losing trade $   -131.000
Ratio avg win/avg loss      6.426   Avg trade(win & loss) $   424.857

Max consec. winners          2      Max consec. losers           3
Avg # bars in winners      146      Avg # bars in losers        38

Max intraday drawdown $  -455.000
Profit factor               8.567   Max # contracts held         1
Account size required $   455.000   Return on account          654%


         Performance Summary:  Long Trades

Total net profit      $  2506.000   Open position P/L    $      0.000
Gross profit          $  2537.000   Gross loss           $    -31.000

Total # of trades            3      Percent profitable          67%
Number winning trades        2      Number losing trades         1

Largest winning trade $  2087.000   Largest losing trade $    -31.000
Average winning trade $  1268.500   Average losing trade $    -31.000
Ratio avg win/avg loss     40.919   Avg trade(win & loss) $   835.333

Max consec. winners          1      Max consec. losers           1
Avg # bars in winners      195      Avg # bars in losers        75

Max intraday drawdown $  -312.000
Profit factor              81.839   Max # contracts held         1
Account size required $   312.000   Return on account          803%


         Performance Summary:  Short Trades

Total net profit      $   468.000   Open position P/L    $      0.000
Gross profit          $   830.000   Gross loss           $   -362.000

Total # of trades            4      Percent profitable          50%
Number winning trades        2      Number losing trades         2

Largest winning trade $   587.000   Largest losing trade $   -219.000
Average winning trade $   415.000   Average losing trade $   -181.000
Ratio avg win/avg loss      2.293   Avg trade(win & loss) $   117.000

Max consec. winners          1      Max consec. losers           2
Avg # bars in winners       97      Avg # bars in losers        20

Max intraday drawdown $  -431.000
Profit factor               2.293   Max # contracts held         1
```

IBM Cubed

Figure 3 Test Window Performance Summary for IBM LSqrNthPwr System 01/02/94-12/31/96

```
LSqr NthPowerPoly  IBM.-Daily   01/04/94 - 12/31/96

        Performance Summary:  All Trades

Total net profit      $  5404.000    Open position P/L    $     0.000
Gross profit          $  5692.000    Gross loss           $  -288.000

Total # of trades            7        Percent profitable         71%
Number winning trades        5        Number losing trades         2

Largest winning trade $  2312.000    Largest losing trade $  -219.000
Average winning trade $  1138.400    Average losing trade $  -144.000
Ratio avg win/avg loss     7.906     Avg trade(win & loss) $   772.000

Max consec. winners          5        Max consec. losers           2
Avg # bars in winners      123        Avg # bars in losers        32

Max intraday drawdown $  -500.000
Profit factor             19.764     Max # contracts held         1

        Performance Summary:  Long Trades

Total net profit      $  5030.000    Open position P/L    $     0.000
Gross profit          $  5099.000    Gross loss           $   -69.000

Total # of trades            4        Percent profitable         75%
Number winning trades        3        Number losing trades         1

Largest winning trade $  2312.000    Largest losing trade $   -69.000
Average winning trade $  1699.667    Average losing trade $   -69.000
Ratio avg win/avg loss    24.633     Avg trade(win & loss) $  1257.500

Max consec. winners          3        Max consec. losers           1
Avg # bars in winners      140        Avg # bars in losers        49

Max intraday drawdown $  -106.000
Profit factor             73.899     Max # contracts held         1

        Performance Summary:  Short Trades

Total net profit      $   374.000    Open position P/L    $     0.000
Gross profit          $   593.000    Gross loss           $  -219.000

Total # of trades            3        Percent profitable         67%
Number winning trades        2        Number losing trades         1

Largest winning trade $   512.000    Largest losing trade $  -219.000
Average winning trade $   296.500    Average losing trade $  -219.000
Ratio avg win/avg loss     1.354     Avg trade(win & loss) $   124.667

Max consec. winners          2        Max consec. losers           1
Avg # bars in winners       99        Avg # bars in losers        14

Max intraday drawdown $  -638.000
Profit factor              2.708     Max # contracts held         1
```

Figure 4 Test Window Performance Summary for IBM LSqrNthPwr System 01/03/95-12/31/97

```
LSqr NthPowerPoly  IBM.-Daily   01/03/95 - 12/31/97

          Performance Summary:  All Trades

Total net profit      $  6583.000    Open position P/L     $      0.000
Gross profit          $  8033.000    Gross loss            $  -1450.000

Total # of trades           23       Percent profitable          61%
Number winning trades       14       Number losing trades         9

Largest winning trade $  2725.000    Largest losing trade  $   -525.000
Average winning trade $   573.786    Average losing trade  $   -161.111
Ratio avg win/avg loss     3.561     Avg trade(win & loss) $    286.217

Max consec. winners          4       Max consec. losers           2
Avg # bars in winners       35       Avg # bars in losers        22

Max intraday drawdown $ -1106.000
Profit factor              5.540     Max # contracts held         1

          Performance Summary:  Long Trades

Total net profit      $  6351.000    Open position P/L     $      0.000
Gross profit          $  7207.000    Gross loss            $   -856.000

Total # of trades           12       Percent profitable          75%
Number winning trades        9       Number losing trades         3

Largest winning trade $  2725.000    Largest losing trade  $   -525.000
Average winning trade $   800.778    Average losing trade  $   -285.333
Ratio avg win/avg loss     2.806     Avg trade(win & loss) $    529.250

Max consec. winners          4       Max consec. losers           1
Avg # bars in winners       33       Avg # bars in losers        14

Max intraday drawdown $  -725.000
Profit factor              8.419     Max # contracts held         1

          Performance Summary:  Short Trades

Total net profit      $   232.000    Open position P/L     $      0.000
Gross profit          $   826.000    Gross loss            $   -594.000

Total # of trades           11       Percent profitable          45%
Number winning trades        5       Number losing trades         6

Largest winning trade $   344.000    Largest losing trade  $   -294.000
Average winning trade $   165.200    Average losing trade  $    -99.000
Ratio avg win/avg loss     1.669     Avg trade(win & loss) $     21.091

Max consec. winners          2       Max consec. losers           2
Avg # bars in winners       39       Avg # bars in losers        26

Max intraday drawdown $  -875.000
Profit factor              1.391     Max # contracts held         1
```

Figure 5 Walk Forward Performance Summary for IBM LSqrNthPwr System

Out Of Sample Performance LSqrNthPwr IBM Daily 1/1/96 - 12/31/98

```
LSqr NthPowerPoly Walk Forward Out-Of-Sample IBM.-Daily   01/03/96 - 12/31/98

        Performance Summary:  All Trades

Total net profit       $ 11920.000    Open position P/L     $      0.000
Gross profit           $ 14356.000    Gross loss            $  -2436.000

Total # of trades            20       Percent profitable          50%
Number winning trades        10       Number losing trades        10

Largest winning trade $ 5663.000      Largest losing trade  $   -525.000
Average winning trade $ 1435.600      Average losing trade  $   -243.600
Ratio avg win/avg loss    5.893       Avg trade(win & loss) $    596.000

Max consec. winners           4       Max consec. losers           4
Avg # bars in winners        63       Avg # bars in losers        22

Max intraday drawdown $ -1511.000
Profit factor             5.893       Max # contracts held         1

        Performance Summary:  Long Trades

Total net profit       $ 12601.000    Open position P/L     $      0.000
Gross profit           $ 13488.000    Gross loss            $   -887.000

Total # of trades            10       Percent profitable          60%
Number winning trades         6       Number losing trades         4

Largest winning trade $  5663.000     Largest losing trade  $   -525.000
Average winning trade $  2248.000     Average losing trade  $   -221.750
Ratio avg win/avg loss   10.138       Avg trade(win & loss) $   1260.100

Max consec. winners           3       Max consec. losers           3
Avg # bars in winners        65       Avg # bars in losers        14

Max intraday drawdown $ -1006.000
Profit factor            15.206       Max # contracts held         1

        Performance Summary:  Short Trades

Total net profit       $  -681.000    Open position P/L     $      0.000
Gross profit           $   868.000    Gross loss            $  -1549.000

Total # of trades            10       Percent profitable          40%
Number winning trades         4       Number losing trades         6

Largest winning trade $   512.000     Largest losing trade  $   -400.000
Average winning trade $   217.000     Average losing trade  $   -258.167
Ratio avg win/avg loss    0.841       Avg trade(win & loss) $    -68.100

Max consec. winners           2       Max consec. losers           3
Avg # bars in winners        59       Avg # bars in losers        27

Max intraday drawdown $ -1787.000
Profit factor             0.560       Max # contracts held         1
```

Figure 6 Walk Forward Performance Summary for Least Squares BP System `01/04/88-12/31/97`

		Power	T	pctup	pctdn	TNPft	%P	MaxDD	LBgLTd	SBgLTd	1YrOpt	1YrOOS
1/1/93	12/31/95	3	34	10.5%	10.5%	$2974	57%	-$455	-$31	-$219		
1/1/94	12/31/96	3	34	10.0%	10.5%	$5404	71%	-$500	-$69	-$219	$3444	$3018
1/1/96	12/31/97	3	34	6.5%	5.0%	$6583	61%	-$1106	$-525	-$294	$2965	$1196
OSS1998	P&L											$7113

Where:
- *TNPft* = Total Net Profit for the **3** year optimized **test** segment.
- *%P* = Percent Profitable for the optimized test segment.
- *MaxDD* = Max Intraday Drawdown in the optimized test segment.
- *LBgLTd* = Long Largest Losing Trade in the optimized test segment.
- *SBgLTd* = Short Largest Losing Trade in the optimized test segment.
- *1YrOpt* = The one year dollar profit for the curve fitted time segment generated from the optimum parameters derived for that time segment. That is this is the curve fitted profit of the last year of the 4 year time segment.
- *1YrOOS* = The walk forward *one year* dollar profit or loss generated from the optimum parameters derived from the *previous* time segment. This is the out-of-sample profit for that year.

IBM Cubed

Entry Date		Entry Price	Exit Date	Exit Price	DysIn Trade	Trade $P&L	Trade %P&L	Trade Max%Pft	Date	Trade Max%DD	Date
930326:5	Sell	25.31	930901	22.88	159	243	9.60%	19.00%	930816	-6.68%	930604
930901:3	Buy	22.88	940208	27.38	160	450	19.67%	30.59%	931217	-9.05%	930929
940208:2	Sell	27.38	940316	28.81	36	-143	-5.22%	4.57%	940307	-5.22%	940316
940316:3	Buy	28.81	940705	28.5	111	-31	-1.08%	12.81%	940614	-9.30%	940420
940705:2	Sell	28.5	940725	30.69	20	-219	-7.68%	2.42%	940711	-9.44%	940721
940725:1	Buy	30.69	950830	51.56	401	2087	68.00%	85.11%	950817	-1.43%	940725
950830:3	Sell	51.56	960122	50.75	145	81	1.57%	19.39%	960115	-1.45%	950830
WALK-FORWARD OUT-OF-SAMPLE TRADES BELOW											
960122:1	Buy	50.75	960308	57.75	46	700	13.79%	26.86%	960227	-0.75%	960122
960308:5	Sell	57.75	960730	52.63	144	512	8.87%	21.85%	960723	-7.90%	960318
960730:2	Buy	52.63	970128	74.94	182	2231	42.39%	59.60%	970121	-2.01%	960730
970128:2	Sell	74.94	970425	76.13	87	-119	-1.59%	13.76%	970404	-4.92%	970130
970425:5	Buy	76.13	970915	98.13	143	2200	28.90%	41.86%	970820	-1.23%	970428
970915:1	Sell	98.13	971119	102	65	-387	-3.94%	8.28%	971027	-8.85%	971007
971119:3	Buy	102	971216	101.13	27	-87	-0.85%	10.67%	971208	-1.59%	971212
971216:2	Sell	101.13	980102	104.5	17	-337	-3.33%	2.59%	971216	-3.46%	971231
980102:5	Buy	104.5	980115	103.19	13	-131	-1.25%	1.86%	980105	-4.25%	980109
980115:4	Sell	103.19	980211	101.63	27	156	1.51%	6.48%	980127	-5.03%	980120
980211:3	Buy	101.63	980305	100.19	22	-144	-1.42%	3.81%	980226	-2.59%	980304
980305:4	Sell	100.19	980320	103	15	-281	-2.80%	4.05%	980309	-2.80%	980320
980320:5	Buy	103	980602	117.19	74	1419	13.78%	22.15%	980514	-1.57%	980323
980602:2	Sell	117.19	980701	116	29	119	1.02%	9.44%	980619	-1.76%	980609
980701:3	Buy	116	980812	128.75	42	1275	10.99%	14.98%	980730	-1.99%	980706
980812:3	Sell	128.75	980915	129	34	-25	-0.19%	12.52%	980831	-1.65%	980826
980915:2	Buy	129	981005	123.75	20	-525	-4.07%	3.59%	980928	-4.07%	981005
981005:1	Sell	123.75	981014	127.75	9	-400	-3.23%	3.64%	981006	-5.76%	981012
981014:3	Buy	127.75	981231	184.38	78	5663	44.33%	48.14%	981228	-2.15%	981014

FIGURE 8
************* MEYERS ANALYTICS TRADE BY TRADE RISK/REWARD SUMMARY *************
IBM LSqrNthPwr System Walk Forward   Summary 01/1/93 – 12/31/98

```
--------COMPOUNDED RATES OF RETURN-------
Buy & Hold w/1.9%Div CompndROR= 43.01%/Yr
Buy w/1.9%Div & Sells w/0.0%Int       CompndROR= 39.75%/Yr
Buy w/1.9%Div & CashOnSells w/5.0%Int CompndROR= 44.10%/Yr
---------------ALL TRADES--------------
TotNetPrft=$14307.00  #Trades= 26  #Wins= 13(50.0%)  PrftFac= 6.06
TotalDays=2106( 5.77yrs) LongPosDays=1319(62.6%) SellPosDays= 787(37.4%)
Ave P&L= 8.76% AvWin=20.34%  AvLoss= -2.82%
        M   T   W   TH   F
Buys    2   5   2   3    1
Sells   2   2   6   0    3
---------------LONG TRADES-------------
#Trades= 13  #Wins=  8(61.5%)  AvDysLng=101
Ave P&L=17.94% AvWin=30.23%  AvLoss= -1.73%
BestWin=       68.00% 950830 WorstLoss= -4.07% 981005
BestMax%Pft= 85.11% 950817 WorstDD=   -9.30% 940420
---------------SHORT TRADES------------
#Trades= 13  #Wins=  5(38.5%)  AvDysSht= 61
Ave P&L=-0.42% AvWin= 4.51%  AvLoss= -3.50%
BestWin=        9.60% 930901 WorstLoss= -7.68% 940725
BestMax%Pft= 21.85% 960723 WorstDD=   -9.44% 940721
```

```
--------COMPOUNDED RATES OF RETURN-------
Buy & Hold w/1.9%Div CompndROR= 48.39%/Yr
Buy w/1.9%Div & Sells w/0.0%Int        CompndROR= 45.82%/Yr
Buy w/1.9%Div & CashOnSells w/5.0%Int CompndROR= 50.51%/Yr
---------------ALL TRADES--------------
TotNetPrft=$11920.00  #Trades= 20  #Wins= 10(50.0%)  PrftFac= 5.89
TotalDays=1219( 3.34yrs) LongPosDays= 647(53.1%) SellPosDays= 572(46.9%)
Ave P&L= 7.22% AvWin=16.71%  AvLoss= -2.27%
        M    T    W   TH    F
Buys    2    3    1    3    1
Sells   1    2    4    0    3
---------------LONG TRADES-------------
#Trades= 10  #Wins=  6(60.0%)  AvDysLng= 65
Ave P&L=14.66% AvWin=25.70%  AvLoss= -1.90%
BestWin=     44.33% 981231 WorstLoss= -4.07% 981005
BestMax%Pft= 59.60% 970121 WorstDD=   -4.25% 980109
---------------SHORT TRADES------------
#Trades= 10  #Wins=  4(40.0%)  AvDysSht= 57
Ave P&L=-0.21% AvWin= 3.24%  AvLoss= -2.52%
BestWin=      8.87% 960730 WorstLoss= -3.94% 971119
BestMax%Pft= 21.85% 960723 WorstDD=   -8.85% 971007
```
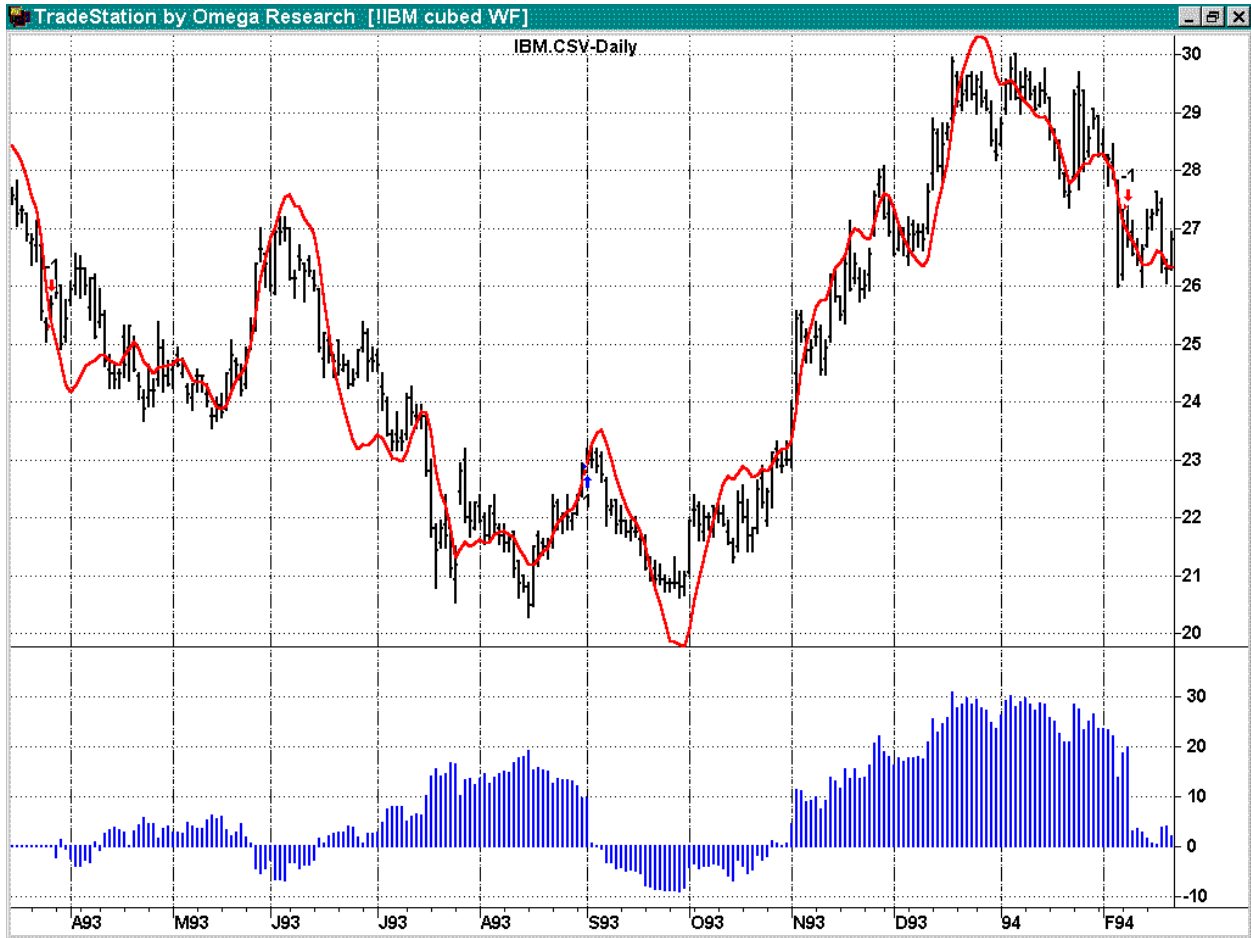
Figure 10b   IBM Daily Bar Chart 1/1/95 – 12/31/98 -   LSqrNthPwr System
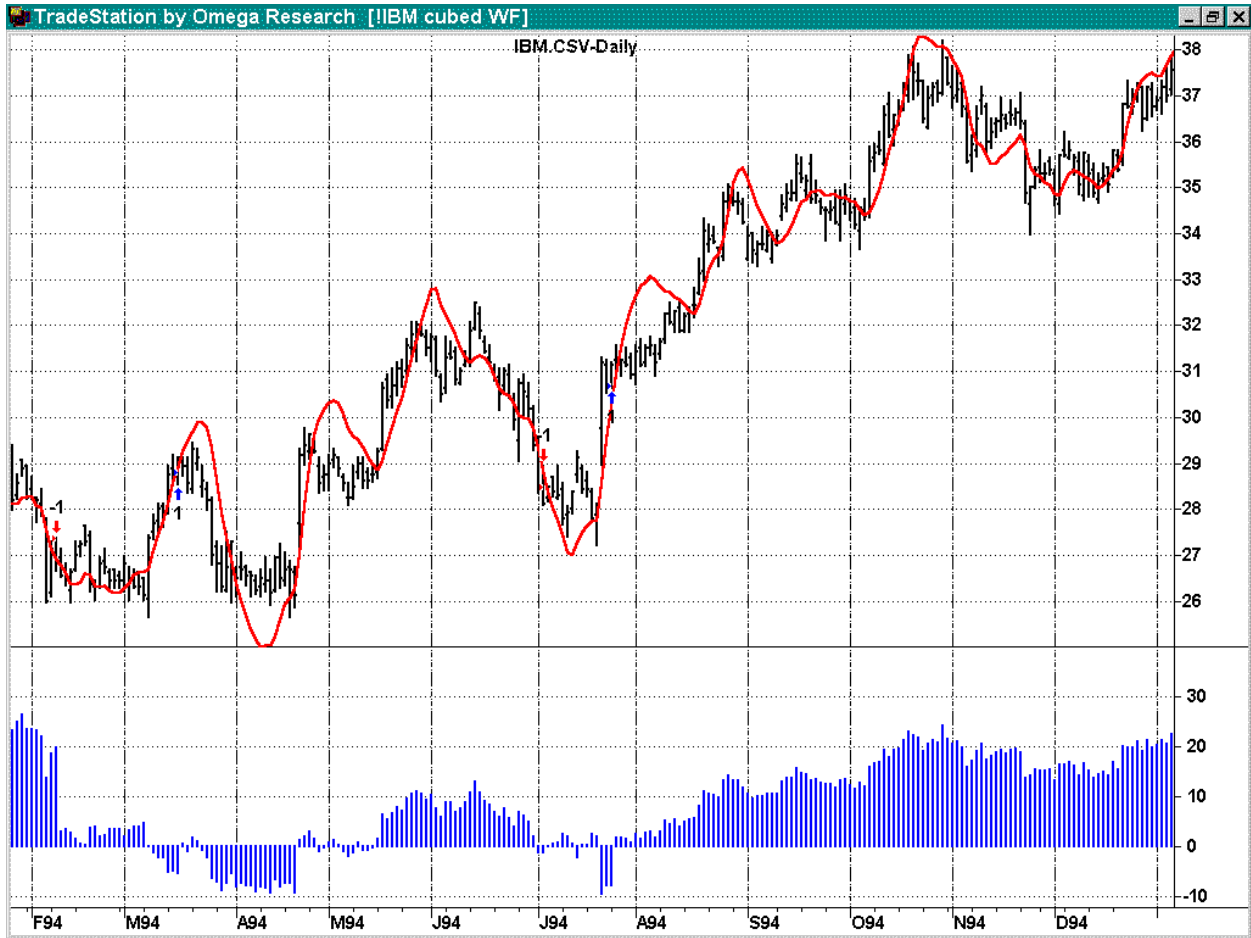
Figure 10c   IBM Daily Bar Chart 1/1/95 – 12/31/98 -   LSqrNthPwr System

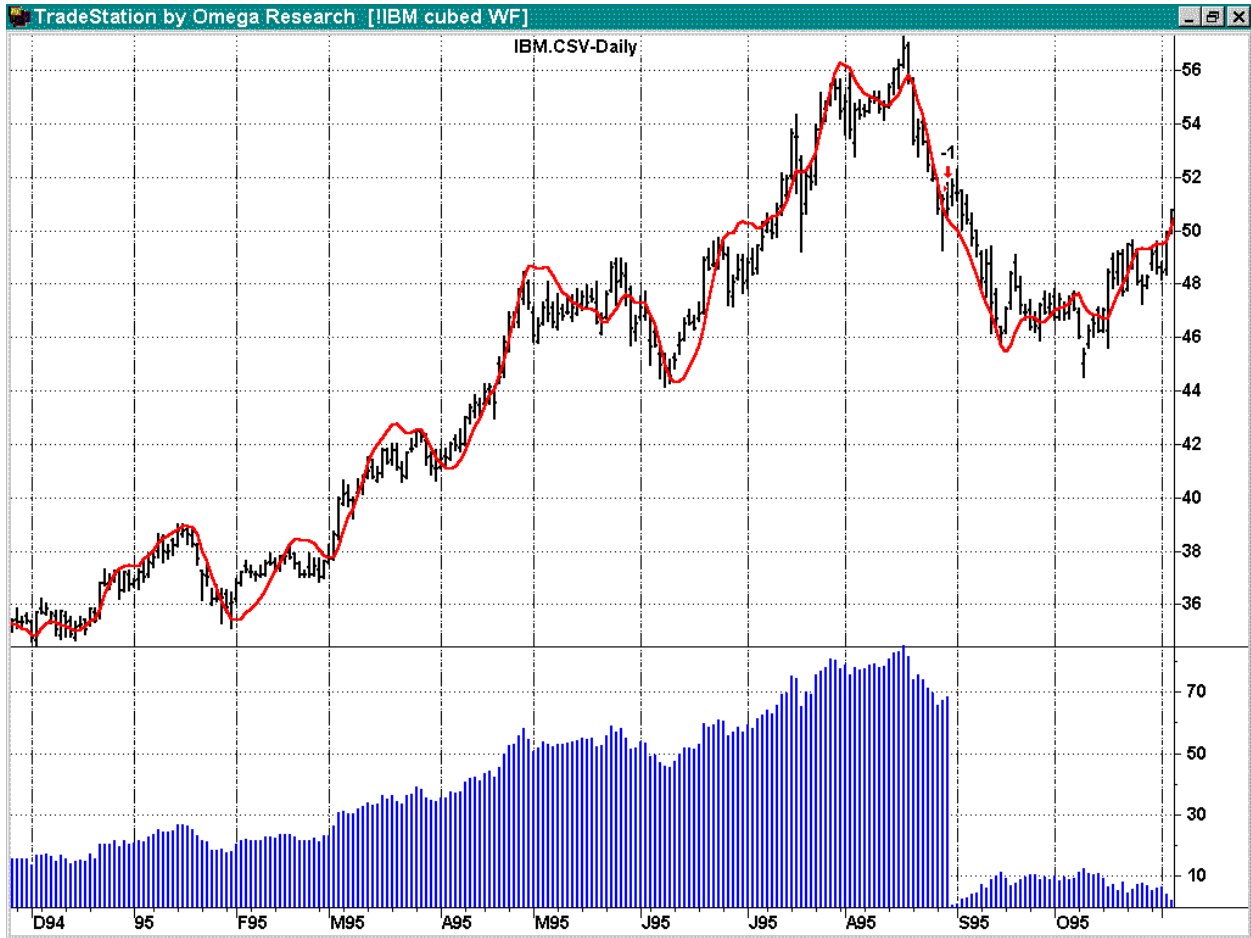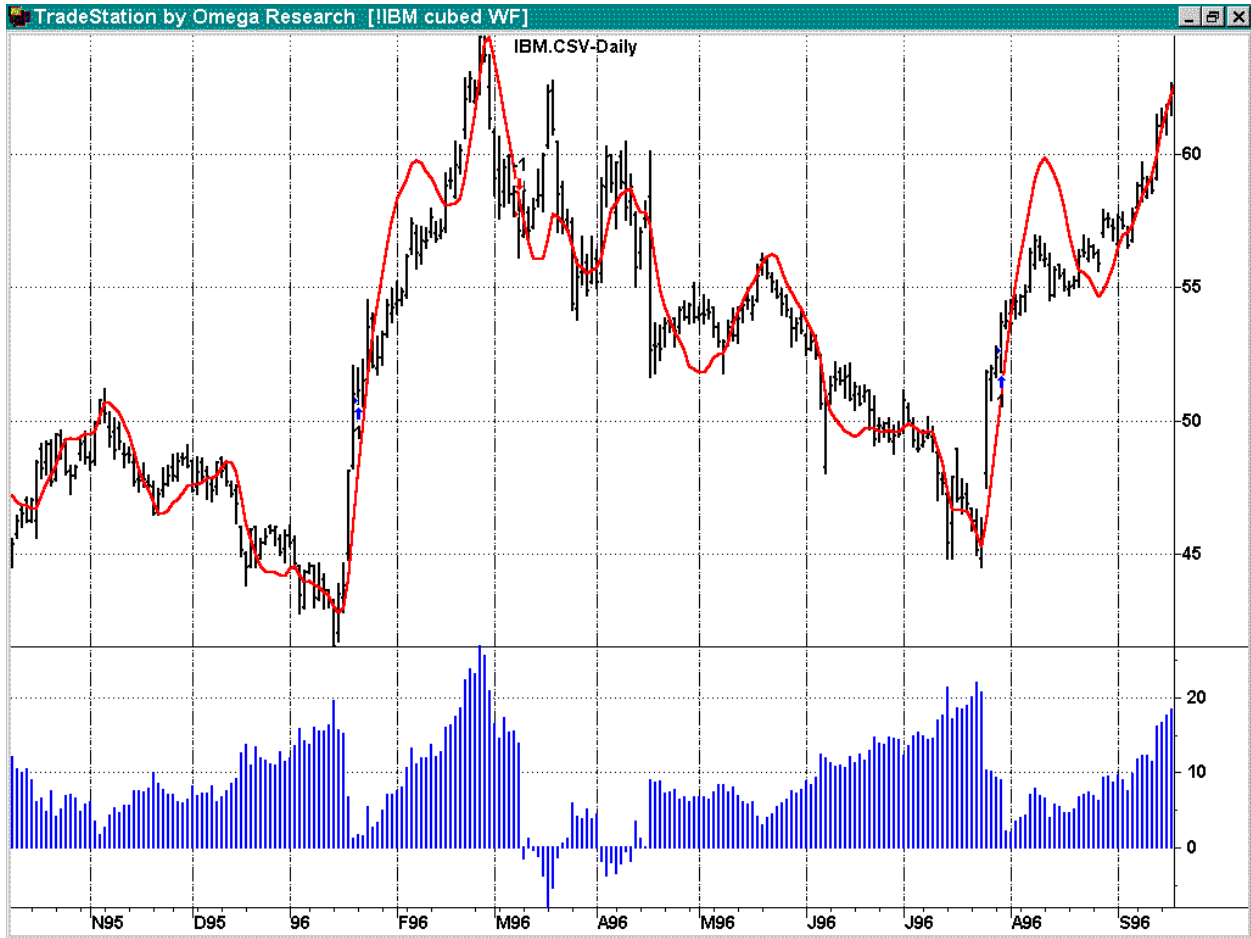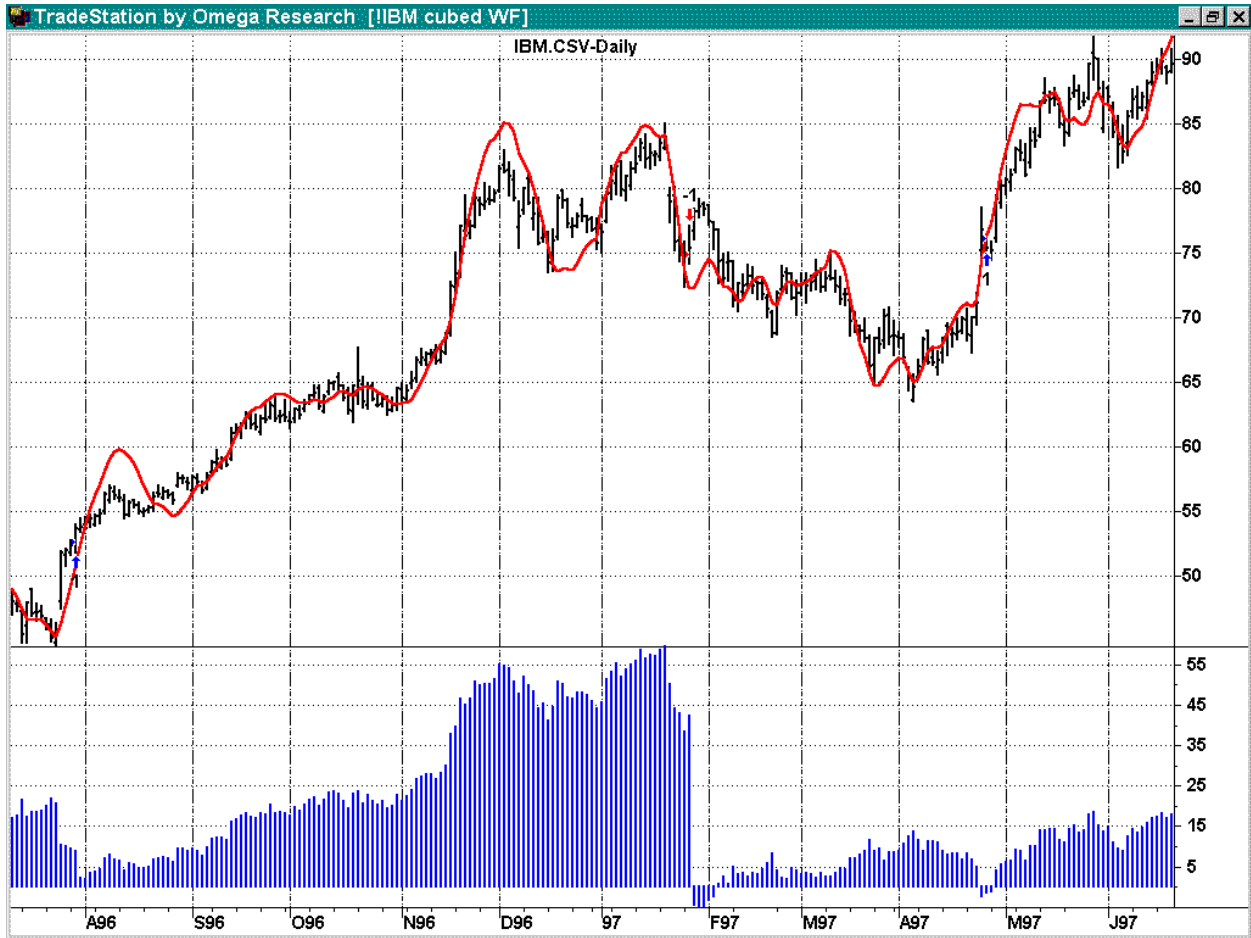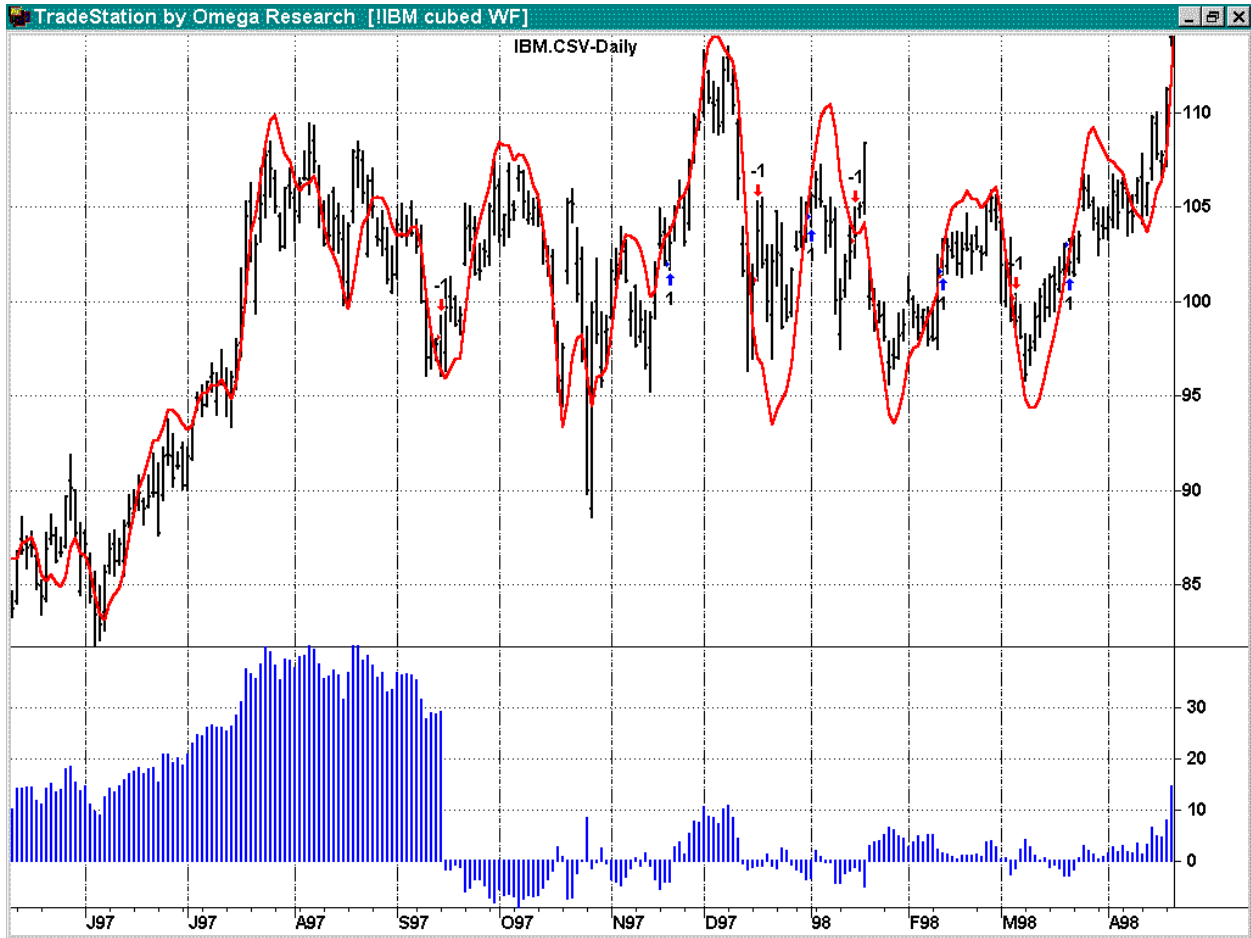**Figure 10d   IBM Daily Bar Chart 1/1/95 – 12/31/98 -   LSqrNthPwr System**

Figure 10e   IBM Daily Bar Chart 1/1/95 – 12/31/98 -   LSqrNthPwr System

IBM Cubed

IBM Cubed