

New World Technologies

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Neural Network Stock Price Prediction Algorithm Results

Example Case #3

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Summary

The concept behind this technology is that company stock price profiles contain patterns that are indicative of future movements and directions. Ted Warren published a book in the 1960s about how to recognize and invest (and profit) based on certain easily recognizable geometric patterns (this approach falls under the heading of Technical Analysis). A type of artificial intelligence, called Artificial Neural Networks, takes this concept a quantum leap forward because it can recognize complex patterns that are not discernable to the human eye. Fundamentally the Neural Network is analyzing the history of the stock and then predicting where the price will end up over the next year (up or down).

Thus a Neural Network is “trained” to recognize patterns in company price and volume (and other data) profiles, and then to predict the high-end or low-end price of each stock over the next year. In this case Neural Networks were trained with inputs spanning a period of 1,200 trading days and outputs of the high/low price points over the next 300 trading days. Refer to pages 5, 6, & 7 for more details.

The performance of each Neural Network is forecast-tested by having it analyze the stock profiles of other companies which were not in its training data set (companies that it had never “seen” before). The Neural Network stock selection set needs to be able to beat the market average Return on Investment (ROI) – that is the net increase/decrease of all of the forecast test stocks over the investment period - in order for it to be considered “successful”.

Of a pool of 100 companies, 50 are used for training of the Neural Networks and the remaining 50 are used for forecast testing of these same Neural Networks. Prior to training and forecast testing, the training/test time window intervals of the companies and their data are shuffled in random order by the software such that they fall somewhere in a 24 year time span between 1991 and 2015.

Summary

These time intervals (set by the software) span 1,200 trading days and are for training input to the Neural Network. The 300 trading days following each of these 1,200 trading day intervals are used for the training output to the Neural Network. Again - these time intervals are randomly selected by the software and can lie anywhere in the 24 year time span interval between 1991 and 2015.

When performing forecast testing, a rule set is implemented which makes the buy/sell decision based on the value of the Neural Network output signal-strength for a particular stock. If the Neural Network predicted price point exceeds the rule set specified percentage of the purchase price, the stock is purchased. The stock is then held until the end of the investment time period (300 trading days) and sold.

The high-achieving Neural Networks (called Super Nets) were able to achieve remarkable ROIs as shown in pages 12 through 25.

Example Case #3 Training Set

In this example case, a pool of 100 companies was used for training and forecast testing purposes. The criteria was that there had to be at least 24 years worth of available financial data. Capitalization and market sector were not considerations in the selection criteria – on the contrary, the selected companies covered a broad range of capitalizations and market sectors from the NYSE and NASDAQ exchanges.

The training and forecast test sets were generated from time windows of 1,500 days for which the start date was randomly selected by the software, inside a 24 year time interval – early 1991 to early 2015.

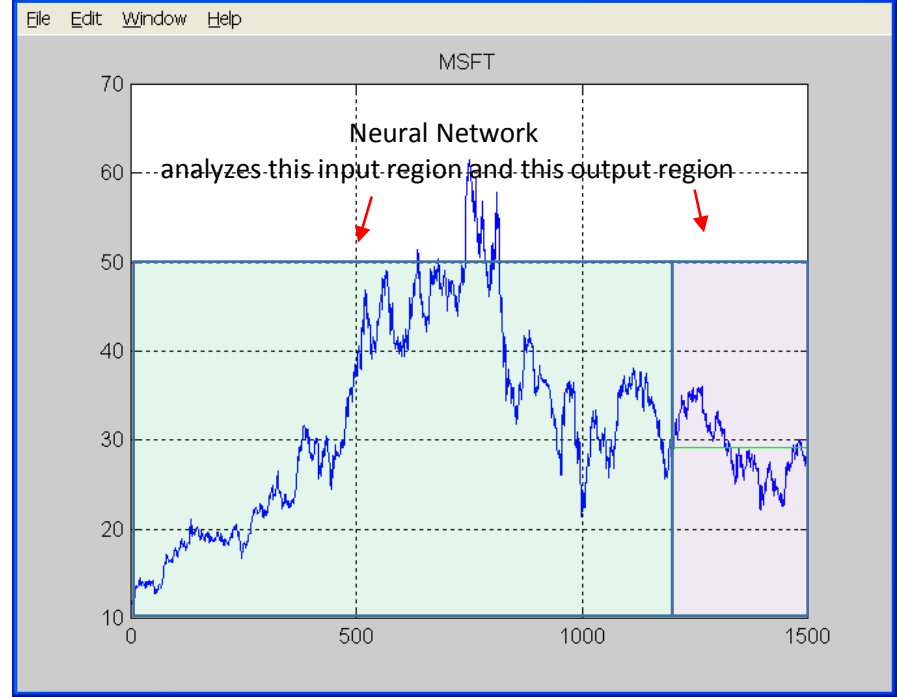
The following 50 companies were used for training,

BAX,	GSK,	BIG,	KR,	WWW,	HOG,	HMC,
ALTR,	HD,	CB,	SAN,	LRCX,	EFX,	PPL,
GE,	PCG,	COP,	ADM,	KO,	WMT,	ENB,
CMCSA,	PEP,	TXN,	BF-A,	ADBE,	ONB,	SYMC,
CPB,	BEN,	CGNX,	MLHR,	EMC,	NKE,	MSFT,
LLTC,	CSX,	ITW,	HAL,	DOW,	DE,	CRUS,
PG,	HPQ,	WY,	CELG,	ED,	JCI,	AVP,
GIS,						

Two examples of the training intervals are shown in the next page.

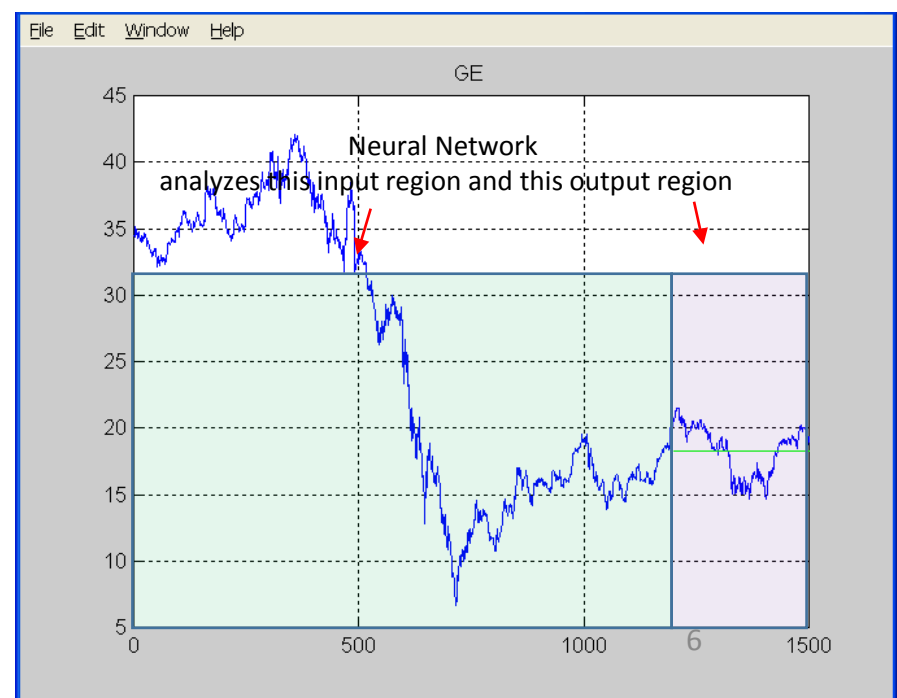
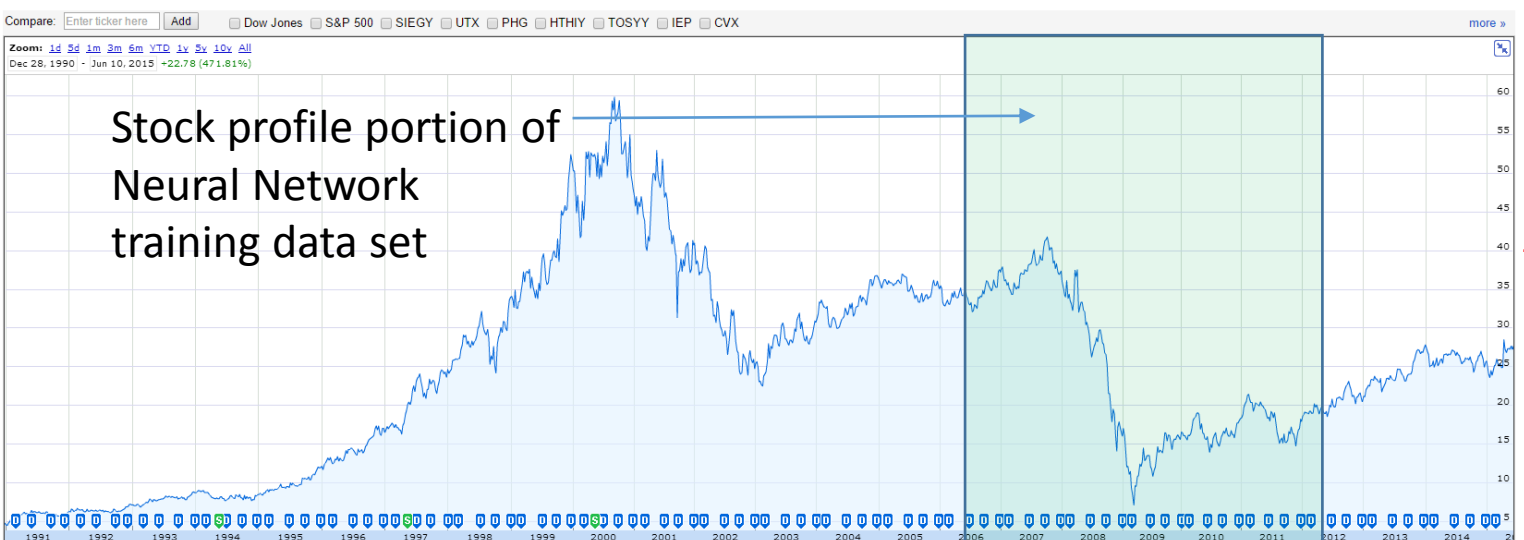
46.61 +0.96 (2.10%)
 Range 45.69 - 46.83 Dividend 0.31/2.66
 52 week 40.12 - 50.04 EPS 2.41
 Open 45.79 Shares 8,09B
 Vol / Avg 27.95M/32.81M Beta 0.98
 Mkt cap 368.34B Inst. own 73%
 P/E 19.36

Dow Jones 18,000.40 1.33%
 Nasdaq 5,076.69 1.25%
 Technology 1.49%
 MSFT 46.61 2.10%



27.61 +0.28 (1.02%)
 Range 27.32 - 27.68 Dividend 0.23/3.33
 52 week 23.41 - 28.68 EPS 0.11
 Open 27.36 Shares 10,08B
 Vol / Avg 33.13M/32.29M Beta 1.42
 Mkt cap 275.97B Inst. own 56%
 P/E 244.34

Dow Jones 18,000.40 1.33%
 S&P 500 2,105.20 1.20%
 Industrials 1.16%
 GE 27.61 1.02%



Example Case #3 Forecast Test Set

The following 50 companies were used for forecast testing.

EA,	DIS,	JBHT,	EXC,	HRL,	JPM,	TSN,
GLW,	XOM,	AIRM,	IDTI,	F,	ETN,	ZION,
MCD,	ORCL,	BMJ,	NUE,	NSC,	CAJ,	PGR,
BCS,	JWN,	CTAS,	TROW,	VLO,	BCE,	ARG,
ATRO,	MMC,	HSY,	CAG,	CTL,	JKHY,	MENT,
HCP,	GT,	GGG,	ADSK,	CASY,	CLX,	KMB,
CAH,	PTC,	AET,	WDC,	ABT,	PFE,	BA,
SSL,						

Market Performance Benchmark

Market investment in all of the test stock

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)	Portfolio Value (\$)
EA	100.0	18.5	23.8	128.2	28.2	128.2
DIS	100.0	20.5	25.9	126.6	26.6	254.8
JBHT	100.0	3.4	3.5	101.4	1.4	356.2
EXC	100.0	21.0	26.9	128.5	28.5	484.7
HRL	100.0	8.4	13.5	160.8	60.8	645.5
JPM	100.0	44.1	24.3	55.2	-44.8	700.6
TSN	100.0	20.3	10.4	51.2	-48.8	751.9
GLW	100.0	32.9	12.0	36.4	-63.6	788.3
XOM	100.0	68.6	80.6	117.4	17.4	905.7
AIRM	100.0	0.7	1.4	194.1	94.1	1099.9
IDTI	100.0	13.8	11.6	84.1	-15.9	1183.9
F	100.0	3.0	11.7	385.9	285.9	1569.8
ETN	100.0	24.6	15.2	61.7	-38.3	1631.5
ZION	100.0	13.4	23.9	177.9	77.9	1809.4
MCD	100.0	26.5	32.4	122.1	22.1	1931.5
ORCL	100.0	32.3	40.1	124.4	24.4	2056.0
BMJ	100.0	24.1	29.6	123.0	23.0	2178.9
NUE	100.0	38.0	49.0	129.0	29.0	2307.9
NSC	100.0	57.6	71.9	124.8	24.8	2432.6
CAJ	100.0	41.1	46.6	113.4	13.4	2546.0
PGR	100.0	6.8	12.3	181.5	81.5	2727.5
BCS	100.0	10.9	11.8	108.4	8.4	2835.9
JWN	100.0	9.6	17.1	177.7	77.7	3013.7
CTAS	100.0	41.1	40.4	98.4	-1.6	3112.0
TROW	100.0	54.3	65.8	121.2	21.2	3233.2
VLO	100.0	8.9	14.6	164.8	64.8	3398.0
BCE	100.0	24.3	26.0	107.0	7.0	3505.1
ARG	100.0	7.4	5.4	73.0	-27.0	3578.1
ATRO	100.0	33.0	27.5	83.4	-16.6	3661.5
MMC	100.0	21.9	24.8	113.4	13.4	3774.8
HSY	100.0	59.5	50.1	84.2	-15.8	3859.0
CAG	100.0	30.4	27.7	91.0	-9.0	3950.0
CTL	100.0	30.2	42.2	139.7	39.7	4089.7
JKHY	100.0	8.6	17.9	208.4	108.4	4298.1

The software “invests” (simulated, of course) an equal amount of money in each of the 50 forecast test companies and only sells the stock at the end of the investment period (300 trading days in this case). This produces a “market average” ROI – in this case the market average ROI for these stocks was **25.2%** (see next page).

Thus the Neural Network stock price predictors have to produce an ROI that beats this number in order to be considered “successful”.

Continued on next page ...

Market Performance Benchmark

MENT	100.0	6.8	9.6	140.9	40.9	4439.0
HCP	100.0	26.3	41.2	156.5	56.5	4595.5
GT	100.0	35.0	19.7	56.2	-43.8	4651.8
GGG	100.0	46.8	71.7	153.3	53.3	4805.1
ADSK	100.0	13.0	6.8	52.6	-47.4	4857.7
CASY	100.0	12.9	14.6	113.2	13.2	4970.9
CLX	100.0	42.8	52.7	123.2	23.2	5094.1
KMB	100.0	59.2	70.9	119.9	19.9	5214.0
CAH	100.0	17.3	33.8	195.6	95.6	5409.7
PTC	100.0	19.0	35.1	184.7	84.7	5594.4
AET	100.0	7.8	10.5	134.3	34.3	5728.7
WDC	100.0	32.9	31.5	95.7	-4.3	5824.4
ABT	100.0	24.5	27.6	112.6	12.6	5937.0
PFE	100.0	16.8	21.7	129.7	29.7	6066.7
BA	100.0	72.7	69.6	95.8	-4.2	6162.5
SSL	100.0	48.1	46.4	96.3	-3.7	6258.8

Initial Market Investment = \$5000.0

Final Market Portfolio Value = \$6258.8

Total Return on Market Investment = 25.2 percent

Performance Results

The total market average ROI for this group of forecast test stocks was 19.2%

Monte Carlo testing was performed by generating 100 Neural Networks (for each Monte Carlo test), each of which was trained on the 50 training stocks and then forecast-tested on all of the 50 forecast test stocks. Each Neural Network would output a predicted price point for each of the 50 forecast test stocks.

When performing forecast testing, a threshold can be set in the software such that only stocks, for which the Neural Network predicts a certain percentage ROI, will be purchased. For example, if the threshold is set at 50%, then only stocks that the Neural Network predicts will have an ROI of 50% or higher will be purchased.

For this set of Monte Carlo test runs, the threshold was set to 50%. The average performance of the Neural Networks for each of the Monte Carlo runs (100 Neural networks generated and each made predictions for each of the 50 forecast test stocks) are shown below:

1. 49.7% @ a threshold of 50%
2. 43.3% @ a threshold of 50%
3. 45.1% @ a threshold of 50%
4. 53.9% @ a threshold of 50%
5. 49.3% @ a threshold of 50%

Performance Results – Super Nets

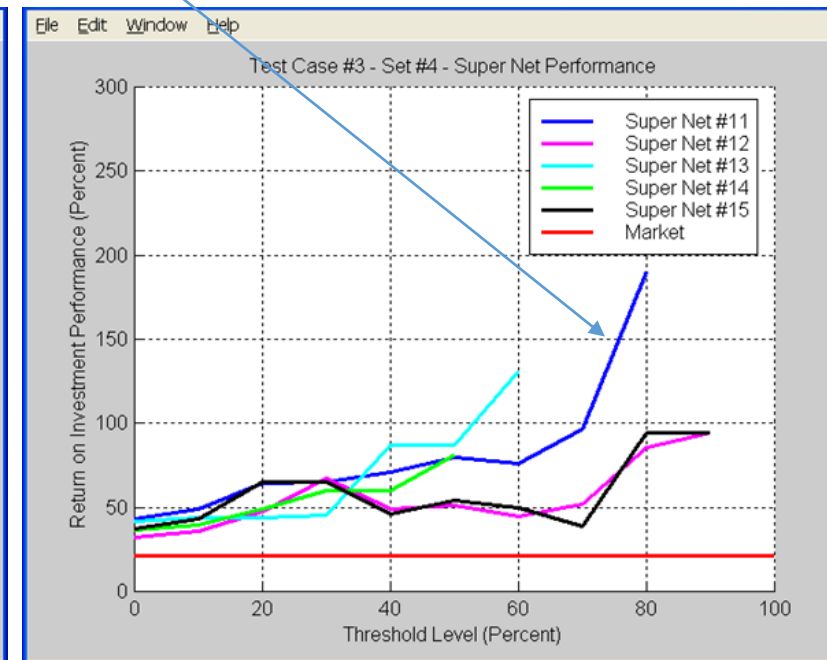
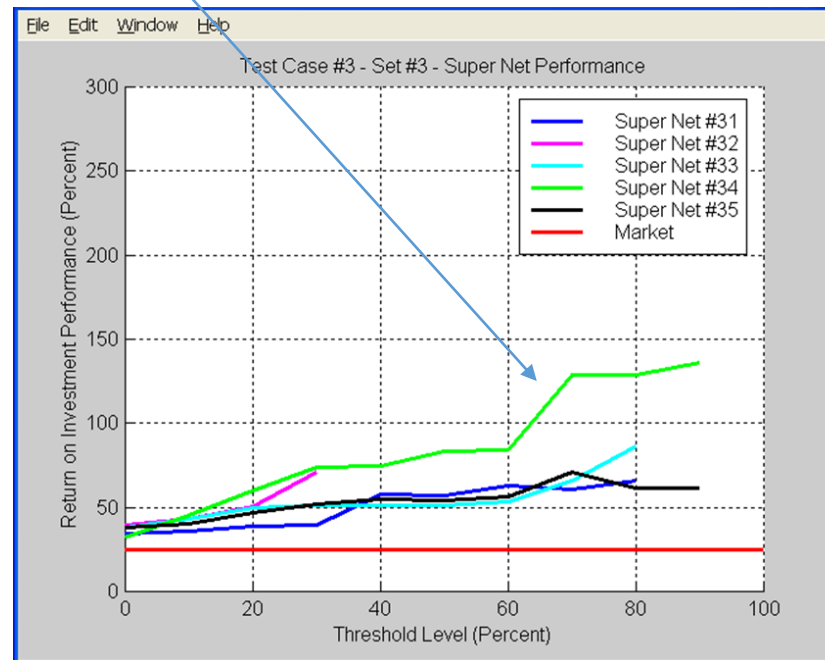
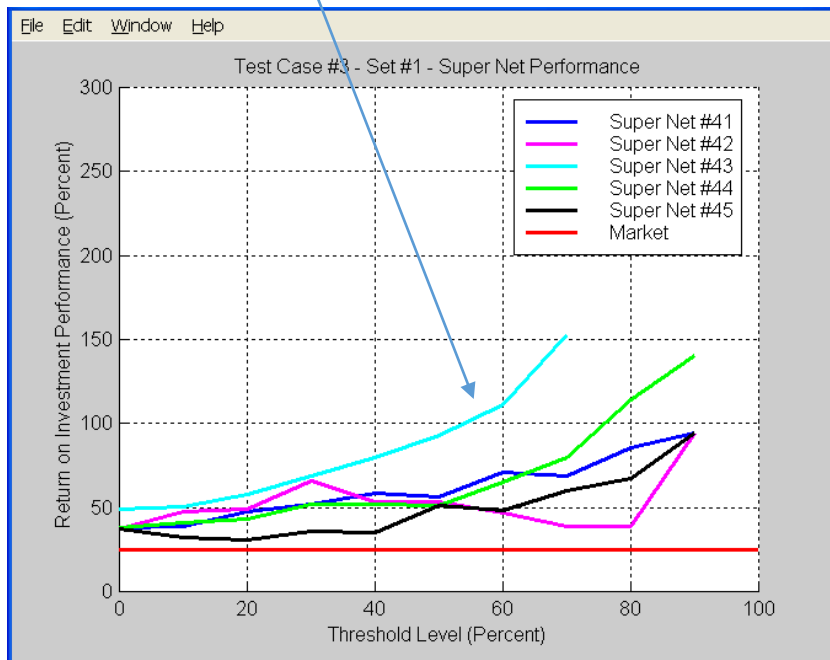
When performing forecast testing, a threshold can be set in the software such that only stocks, for which the Neural Network predicts a certain percentage ROI, will be purchased. For example, if the threshold is set at 50%, then only stocks for which the Neural Network predicts will have an ROI of 50% or higher will be purchased.

Several sets of high-achieving Neural Networks, called “Super Nets”, were generated to demonstrate their superior performance in picking stocks at the various threshold levels. The rest of the document discusses the performances for three Super Nets.

Performance Results – Super Nets

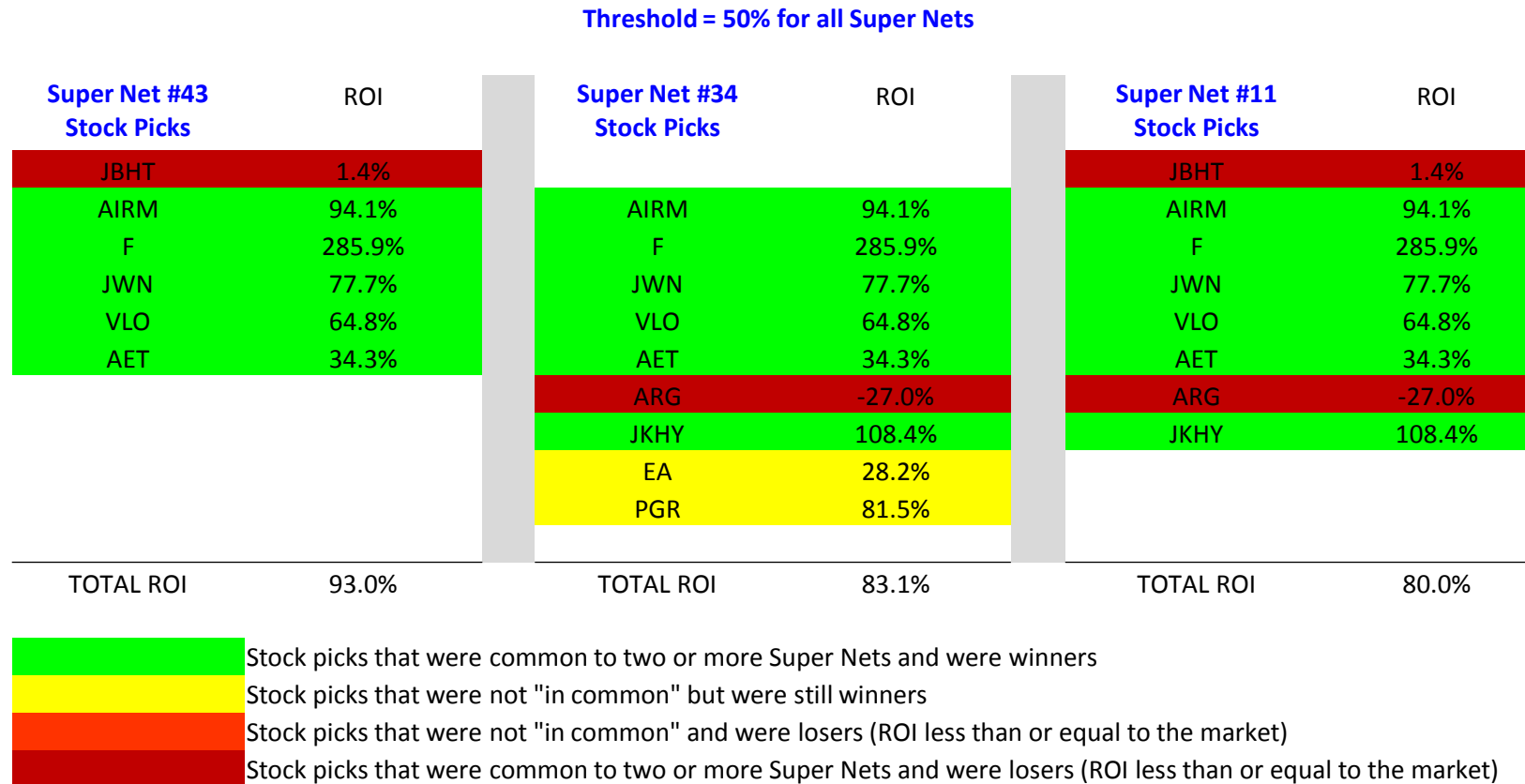
The plots on this page show Super Net ROI performance for threshold levels varying from 0% to 100%. The market ROI (aggregate return of all forecast test companies) of **25.2%** is shown in red for comparison purposes.

Super Net 43 (Set 1, below left), Super Net 34 (Set 3, below middle), and Super Net 11 (Set 4, below right) were selected to demonstrate performance in subsequent pages.



Performance Results – Super Nets

A comparison of the three Super Net stock picks, at the 50% threshold level, is shown below. Notice that there is overlap between the three Super Nets and that one of the Super Nets also picked two more winners as well. These Super Nets can be combined as a “Wolf Pack” to hunt together for stocks that are going to rise significantly in the next year.



Super Net #43 Performance

The performance of Super Net #43 (Set 1) is demonstrated on the following page for threshold levels 70%, 50%, and 30%. Note that the advantage of using the lower threshold levels is that an investor can maintain a larger diversified portfolio of stocks while still achieving superior ROIs.

On the next page, performance at the 70% threshold level is shown on the top left section. The performance at the 50% threshold level is shown in the middle. The performance at the 30% threshold level is shown on the lower right section.

A green bar represents a winning stock pick that was added to the portfolio as the threshold was dropped. A red bar represents a losing stock pick that was added to the portfolio. Note that “losing stock pick” refers to any stock that performs at the same level of the market ROI (25.2% in this case) or below.

Super Net #43 Performance

Neural Network Rule Set Threshold = 70.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
JWN	100.0	9.6	17.1	177.7	77.7

The threshold is lowered to 50% and the Super Net picks 3 more companies – two are big winners and one is a minor loser

Initial NNet Investment = \$300.0

Final NNet Portfolio Value = \$757.7

Total Return on NNet Investment = 152.6 percent

Neural Network Rule Set Threshold = 50.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
JBHT	100.0	3.4	3.5	101.4	1.4 ■
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
JWN	100.0	9.6	17.1	177.7	77.7
VLO	100.0	8.9	14.6	164.8	64.8 ■
AET	100.0	7.8	10.5	134.3	34.3 ■

The threshold is lowered to 30% and the Super Net picks 7 more companies – four are big winners, one is a minor winner, one is a minor loser, and one is a significant loser.

Initial NNet Investment = \$600.0

Final NNet Portfolio Value = \$1158.3

Total Return on NNet Investment = 93.0 percent

Neural Network Rule Set Threshold = 30.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
JBHT	100.0	3.4	3.5	101.4	1.4
EXC	100.0	21.0	26.9	128.5	28.5 ■
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
ZION	100.0	13.4	23.9	177.9	77.9 ■
CAJ	100.0	41.1	46.6	113.4	13.4 ■
JWN	100.0	9.6	17.1	177.7	77.7
VLO	100.0	8.9	14.6	164.8	64.8
ARG	100.0	7.4	5.4	73.0	-27.0 ■
JKHY	100.0	8.6	17.9	208.4	108.4 ■
GGG	100.0	46.8	71.7	153.3	53.3 ■
PTC	100.0	19.0	35.1	184.7	84.7 ■
AET	100.0	7.8	10.5	134.3	34.3

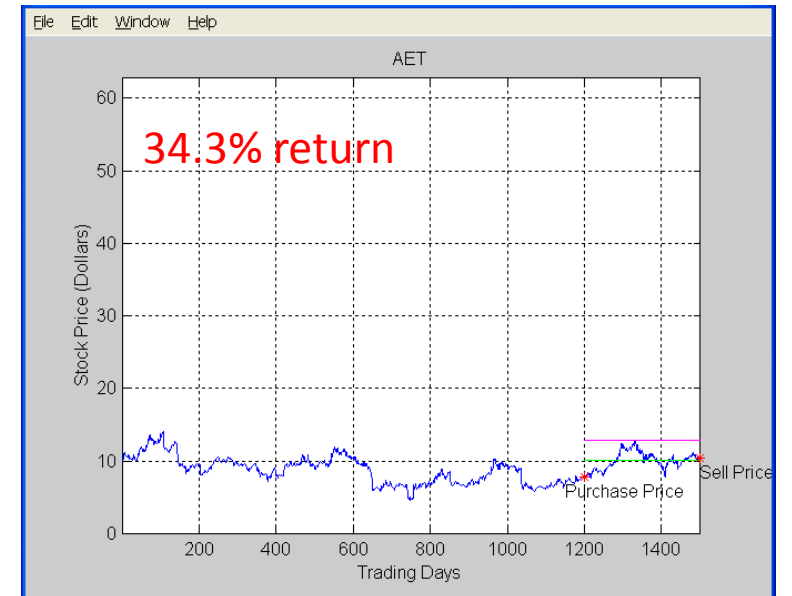
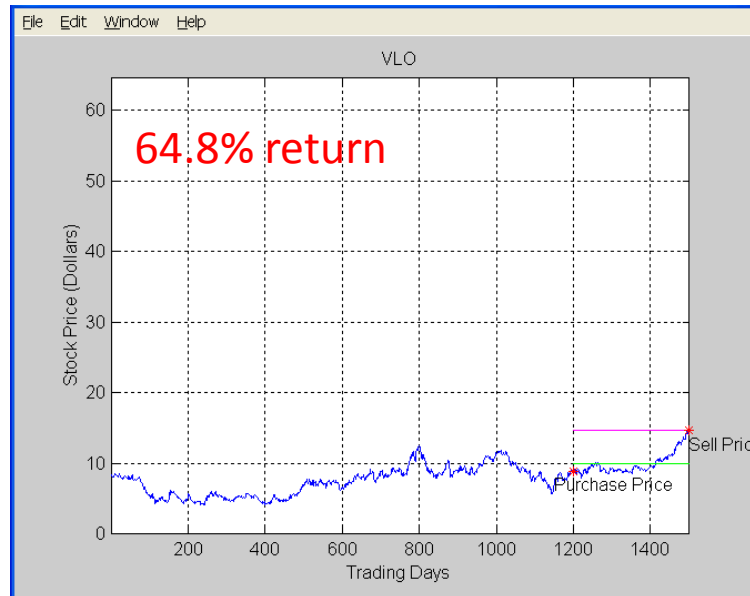
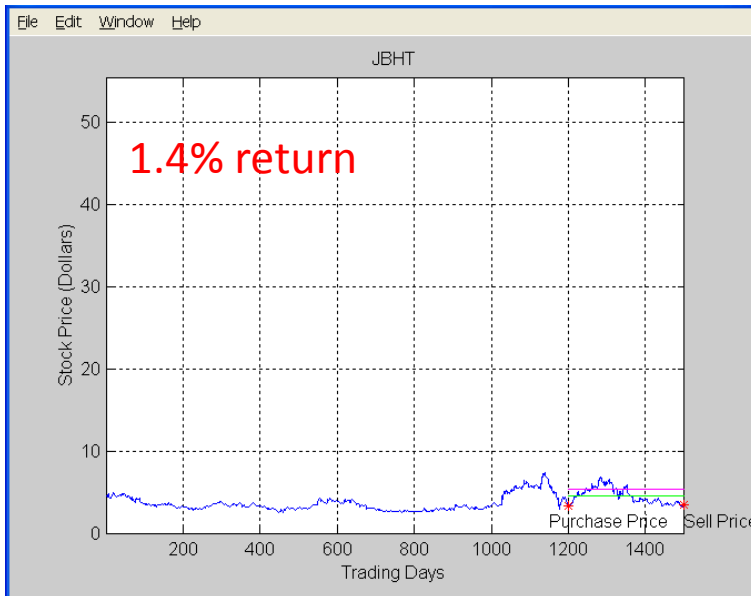
Initial NNet Investment = \$1300.0

Final NNet Portfolio Value = \$2197.5

Total Return on NNet Investment = 69.0 percent

Super Net #43 Performance

The following plots are of the three companies that were added to the mix for the 50% threshold level.



Super Net #34 Performance

The performance of Super Net #34 (Set 3) is demonstrated on the following page for threshold levels 70%, 50%, and 30%. Note that the advantage of using the lower threshold levels is that an investor can maintain a larger diversified portfolio of stocks while still achieving superior ROIs.

On the next page, performance at the 70% threshold level is shown in the top left section. The performance at the 50% threshold level is shown in the middle. The performance at the 30% threshold level is shown in the lower right section.

A green bar represents a winning stock pick that was added to the portfolio as the threshold was dropped. A red bar represents a losing stock pick that was added to the portfolio. Note that “losing stock pick” refers to any stock that performs at the same level of the market (25.2% in this case) or below.

Super Net #34 Performance

Neural Network Rule Set Threshold = 70.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
EA	100.0	18.5	23.8	128.2	28.2
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
JKHY	100.0	8.6	17.9	208.4	108.4

The threshold is lowered to 50% and the Super Net picks 5 more companies – three are big winners, one is a minor winner, and one is a significant loser.

Initial NNet Investment = \$400.0

Final NNet Portfolio Value = \$916.6

Total Return on NNet Investment = 129.1 percent

percent

				Sell Value (\$)	ROI (percent)
EA	100.0	18.5	23.8	128.2	28.2
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
PGR	100.0	6.8	12.3	181.5	81.5
JWN	100.0	9.6	17.1	177.7	77.7
VLO	100.0	8.9	14.6	164.8	64.8
ARG	100.0	7.4	5.4	73.0	-27.0
JKHY	100.0	8.6	17.9	208.4	108.4
AET	100.0	7.8	10.5	134.3	34.3

The threshold is lowered to 30% and the Super Net picks 2 more companies – one is a big winner, and the other is a minor loser.

Initial NNet Investment = \$900.0

Final NNet Portfolio Value = \$1647.9

Total Return on NNet Investment = 83.1 percent

Neural Network Rule Set Threshold = 30.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
EA	100.0	18.5	23.8	128.2	28.2
JBHT	100.0	3.4	3.5	101.4	1.4
HRL	100.0	8.4	13.5	160.8	60.8
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
PGR	100.0	6.8	12.3	181.5	81.5
JWN	100.0	9.6	17.1	177.7	77.7
VLO	100.0	8.9	14.6	164.8	64.8
ARG	100.0	7.4	5.4	73.0	-27.0
JKHY	100.0	8.6	17.9	208.4	108.4
AET	100.0	7.8	10.5	134.3	34.3

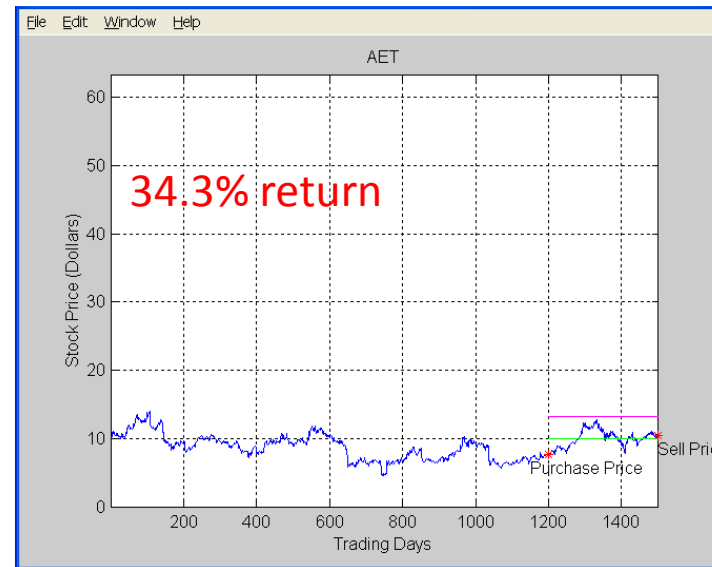
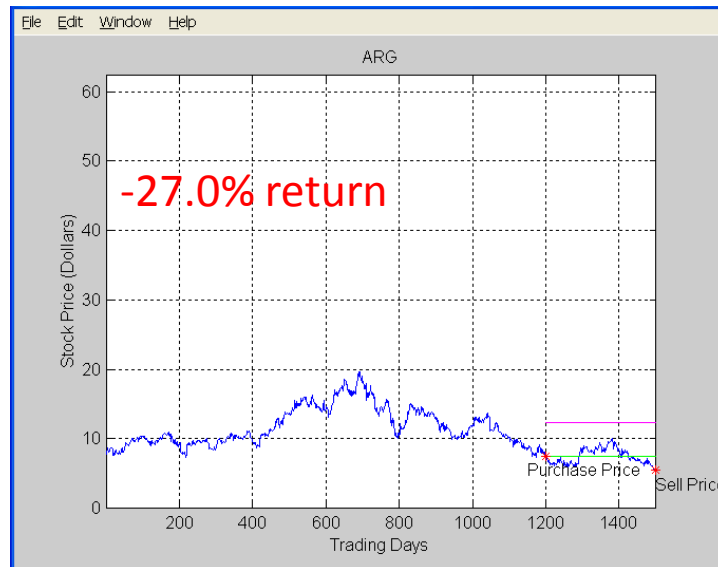
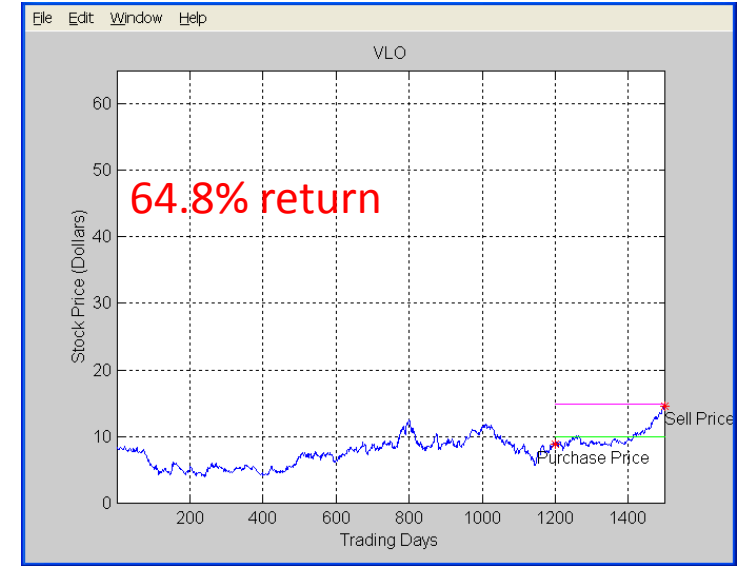
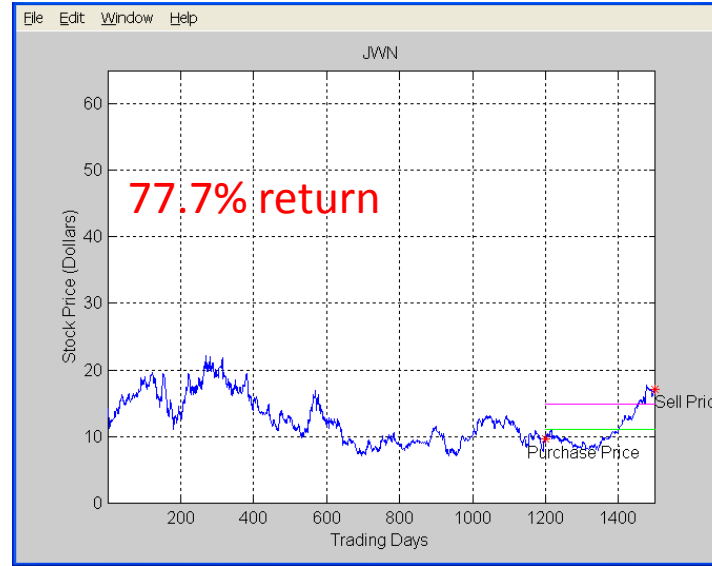
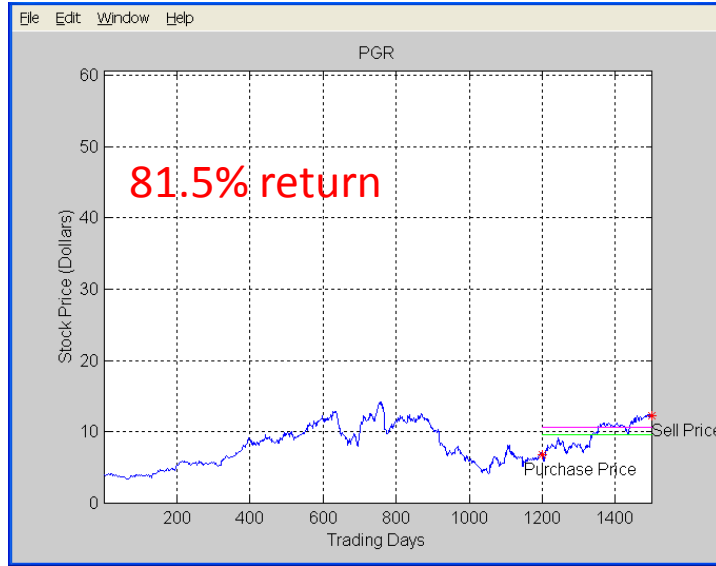
Initial NNet Investment = \$1100.0

Final NNet Portfolio Value = \$1910.1

Total Return on NNet Investment = 73.6 percent

Super Net #34 Performance

The following plots are of the five companies that were added to the mix for the 50% threshold level.



Super Net #11 Performance

The performance of Super Net #11 (Set 4) is demonstrated on the following page for threshold levels 70%, 50%, and 30%. Note that the advantage of using the lower threshold levels is that an investor can maintain a larger diversified portfolio of stocks while still achieving superior ROIs.

On the next page, performance at the 70% threshold level is shown on the top left section. The performance at the 50% threshold level is shown in the middle. The performance at the 30% threshold level is shown on the lower right section.

A green bar represents a winning stock pick that was added to the portfolio as the threshold was dropped. A red bar represents a losing stock pick that was added to the portfolio. Note that “losing stock pick” refers to any stock that performs at the same level of the market (25.2% in this case) or below.

Super Net #11 Performance

Neural Network Rule Set Threshold = 70.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
ARG	100.0	7.4	5.4	73.0	-27.0
AET	100.0	7.8	10.5	134.3	34.3

The threshold is lowered to 50% and the Super Net picks 4 more companies – three are big winners, one is a minor loser.

Initial NNet Investment = \$400.0

Final NNet Portfolio Value = \$787.3

Total Return on NNet Investment = 96.8 percent

Neural Network Rule Set Threshold = 50.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
JBHT	100.0	3.4	3.5	101.4	1.4 ■
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
JWN	100.0	9.6	17.1	177.7	77.7 ■
VLO	100.0	8.9	14.6	164.8	64.8 ■
ARG	100.0	7.4	5.4	73.0	-27.0
JKHY	100.0	8.6	17.9	208.4	108.4 ■
AET	100.0	7.8	10.5	134.3	34.3

Initial NNet Investment = \$800.0

Final NNet Portfolio Value = \$1439.7

Total Return on NNet Investment = 80.0 percent

The threshold is lowered to 30% and the Super Net picks 7 more companies – four are major winners, three are minor losers.

Neural Network Rule Set Threshold = 30.0 percent

Company	Initial Investment (\$)	Purchase Price (\$)	Sell Price (\$)	Sell Value (\$)	ROI (percent)
JBHT	100.0	3.4	3.5	101.4	1.4
HRL	100.0	8.4	13.5	160.8	60.8 ■
AIRM	100.0	0.7	1.4	194.1	94.1
F	100.0	3.0	11.7	385.9	285.9
PGR	100.0	6.8	12.3	181.5	81.5 ■
JWN	100.0	9.6	17.1	177.7	77.7
VLO	100.0	8.9	14.6	164.8	64.8
ARG	100.0	7.4	5.4	73.0	-27.0
JKHY	100.0	8.6	17.9	208.4	108.4
GGG	100.0	46.8	71.7	153.3	53.3 ■
CASY	100.0	12.9	14.6	113.2	13.2 ■
CLX	100.0	42.8	52.7	123.2	23.2 ■
KMB	100.0	59.2	70.9	119.9	19.9 ■
PTC	100.0	19.0	35.1	184.7	84.7 ■
AET	100.0	7.8	10.5	134.3	34.3

Initial NNet Investment = \$1500.0

Final NNet Portfolio Value = \$2476.3

Total Return on NNet Investment = 65.1 percent

Super Net #11 Performance

The following plots are of the four companies that were added to the mix for the 50% threshold level.

