3

Naive System

Before expending a lot of energy designing and testing mean reversion systems, we will examine a naive system to see whether SPY, and other highly liquid ETFs and equities exhibit mean reversion or trend following behavior.

As readers of my companion book, Modeling Trading System Performance, will recognize, I recommend systems that trade frequently, hold for a short period of time, and have a high percentage of winning trades. The systems described in this chapter are not finished systems. They are intended to be exploratory and should not be traded without extensive testing and validation by the trader.

Buy After an N-Day Sequence

Defining a day as either a rising day or a falling day based on whether the most recent close is higher or lower than the previous day's close, we can test the feasibility of buying after a sequence of rising days or a sequence of falling days.

Every trading system involves making some subjective decisions. For this system, they include:

- Issue traded — SPY
- Date range — 1/1/1999 to 1/1/2012
- Indicator — A sequence of rising or falling daily prices.
- Action — At the close of the signal bar.
- Commission and slippage — none.
- Positions — Long only.
- Objective function — CAR / MDD.

- Initial equity — $100,000.
- Maximum open positions — 1
- Position size — Fixed at $10,000

Every system has some parameters. For this system they include:

- N — The number of consecutive closes in the same direction.
- Direction — Rising (1) or falling (0).
- HoldDays — Maximum holding period in days.
- ProfitTarget — Exit intra-day when this percent profit can be realized.

The rules are:

- Buy — N consecutive closes in the same direction.
- Sell — At the close of the maximum holding period, or at the profit target, whichever is reached first.

Listing 3.1 shows the AmiBroker code.

```
//   BuyAfterAnNDaySequence.afl
//

SetOption( "ExtraColumnsLocation", 1 );
SetOption ( "CommissionMode", 2 ); // $ per trade
SetOption( "CommissionAmount", 0 );
SetOption( "InitialEquity", 100000 );
SetPositionSize( 10000, spsValue );
MaxPos = 1;
SetOption( "MaxOpenPositions", MaxPos );
SetTradeDelays( 0, 0, 0, 0 );
BuyPrice = Close;
SellPrice = Close;

//  Define a day as rising based on the closing price
Rising = C > Ref( C, -1 );
Falling = C < Ref( C, -1 );

// The number of days in the sequence
N = Optimize( "N", 3, 1, 7, 1 );

//  Direction.  1 == Rising, 0 == Falling
Direction = Optimize( "Direction", 1, 0, 1, 1 );

//  Exit variables
//  Maximum holding period
HoldDays = Optimize( "HoldDays", 4, 1, 7, 1 );
//  Profit target
ProfitTarget = Optimize( "ProfitTarget", 0.4, 0.2, 4, 0.2 );

//  Detect an N day sequence

if ( Direction == 1 )
{
    NDaySequence = Sum( Rising, N ) == N;
}
```

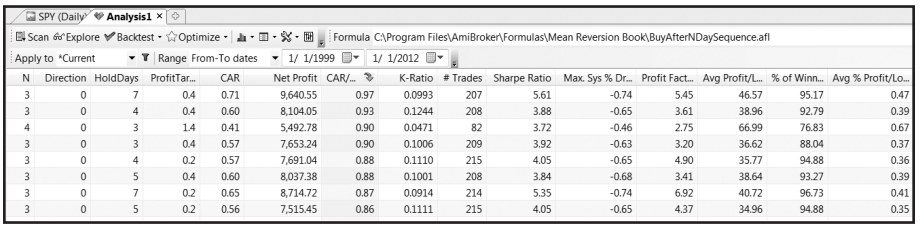
```
else
{
    NDaySequence = Sum( Falling, N ) == N;
}

Buy = NDaySequence;
Sell = 0;

ApplyStop( stopTypeProfit, stopModePercent, ProfitTarget );
ApplyStop( stopTypeNBar, stopModeBars, HoldDays );

///////////////  end  ////////////////
```

Listing 3.1 -- Buy After an N-Day Sequence

The optimization statements call for testing of:

- N days from 1 to 7.
- Direction both Rising and Falling.
- Holding Period from 1 day to 7. In AmiBroker, both the entry day and the exit day are counted. Since entry is made at the close of one day and the earliest exit is at a profit target the following day, the shortest period reported will be for a 2 day holding period.
- ProfitTarget from 0.2% to 4.0%.

Figure 3.1 shows the result of the optimization, sorted by CAR / MDD (Compound Annual Return / Maximum Drawdown).


SPY (Daily) Analysis1 ×

Scan Explore Backtest Optimize Formula C:\Program Files\AmiBroker\Formulas\Mean Reversion Book\BuyAfterNDaySequence.afl

Apply to: Current Range: From-To dates 1/ 1/1999 1/ 1/2012

N	Direction	HoldDays	ProfitTar...	CAR	Net Profit	CAR/...	K-Ratio	# Trades	Sharpe Ratio	Max. Sys % Dr...	Profit Fact...	Avg Profit/L...	% of Winn...	Avg % Profit/Lo...
3	0	7	0.4	0.71	9,640.55	0.97	0.0993	207	5.61	-0.74	5.45	46.57	95.17	0.47
3	0	4	0.4	0.60	8,104.05	0.93	0.1244	208	3.88	-0.65	3.61	38.96	92.79	0.39
4	0	3	1.4	0.41	5,492.78	0.90	0.0471	82	3.72	-0.46	2.75	66.99	76.83	0.67
3	0	3	0.4	0.57	7,653.24	0.90	0.1006	209	3.92	-0.63	3.20	36.62	88.04	0.37
3	0	4	0.2	0.57	7,691.04	0.88	0.1110	215	4.05	-0.65	4.90	35.77	94.88	0.36
3	0	5	0.4	0.60	8,037.38	0.88	0.1001	208	3.84	-0.68	3.41	38.64	93.27	0.39
3	0	7	0.2	0.65	8,714.72	0.87	0.0914	214	5.35	-0.74	6.92	40.72	96.73	0.41
3	0	5	0.2	0.56	7,515.45	0.86	0.1111	215	4.05	-0.65	4.37	34.96	94.88	0.35

Figure 3.1 -- Optimization results

The parameters are in the first four columns in the same order they occur in the program. Namely, N, Direction, HoldDays, ProfitTarget.

Note that the best result has parameter values of 3, 0, 7, 0.4. Buy at the close of a day that completes a sequence of 3 falling days, take a profit of 0.4% as soon as possible, exit at the close of the 7th day (6th day after entry). And the second best, which has a better K-ratio, exits on day 4.

Figure 3.2 shows the equity curves and drawdown curves for the best system (with the seven day hold).

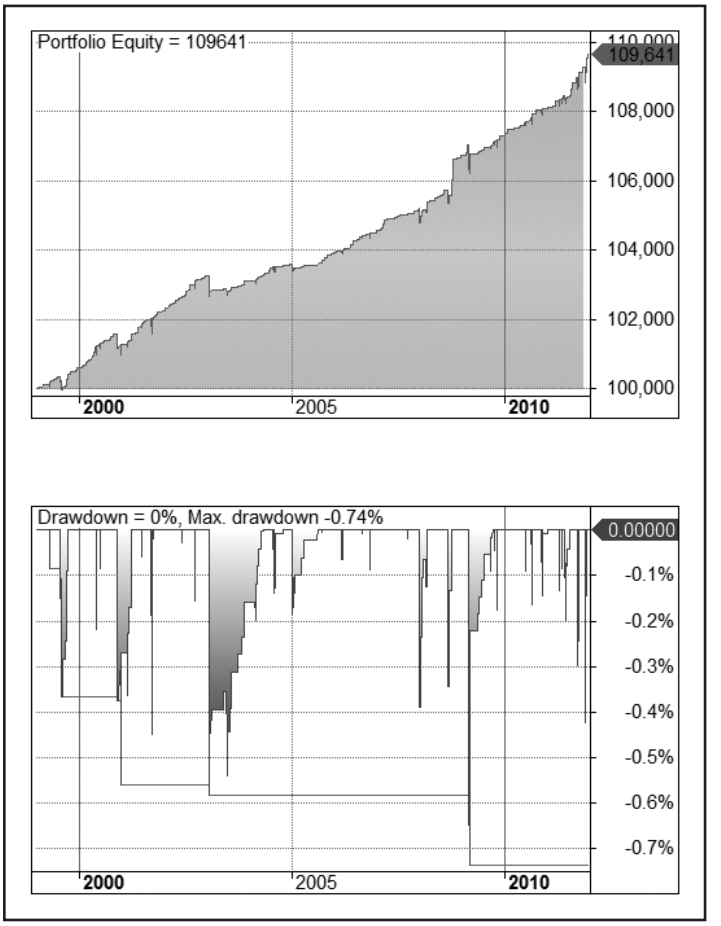
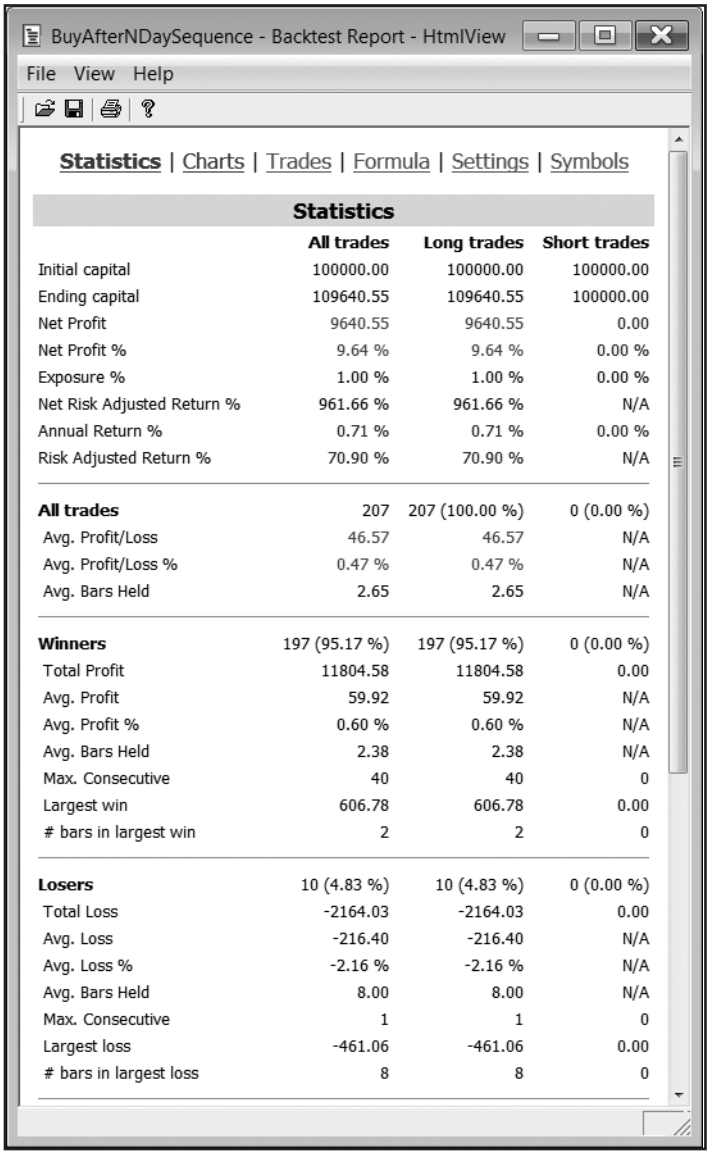


Figure 3.2 -- Equity curve and drawdown curve

Figure 3.3 shows the statistics for the best system.



Statistics

	All trades	Long trades	Short trades
Initial capital	100000.00	100000.00	100000.00
Ending capital	109640.55	109640.55	100000.00
Net Profit	9640.55	9640.55	0.00
Net Profit %	9.64 %	9.64 %	0.00 %
Exposure %	1.00 %	1.00 %	0.00 %
Net Risk Adjusted Return %	961.66 %	961.66 %	N/A
Annual Return %	0.71 %	0.71 %	0.00 %
Risk Adjusted Return %	70.90 %	70.90 %	N/A
All trades	207	207 (100.00 %)	0 (0.00 %)
Avg. Profit/Loss	46.57	46.57	N/A
Avg. Profit/Loss %	0.47 %	0.47 %	N/A
Avg. Bars Held	2.65	2.65	N/A
Winners	197 (95.17 %)	197 (95.17 %)	0 (0.00 %)
Total Profit	11804.58	11804.58	0.00
Avg. Profit	59.92	59.92	N/A
Avg. Profit %	0.60 %	0.60 %	N/A
Avg. Bars Held	2.38	2.38	N/A
Max. Consecutive	40	40	0
Largest win	606.78	606.78	0.00
# bars in largest win	2	2	0
Losers	10 (4.83 %)	10 (4.83 %)	0 (0.00 %)
Total Loss	-2164.03	-2164.03	0.00
Avg. Loss	-216.40	-216.40	N/A
Avg. Loss %	-2.16 %	-2.16 %	N/A
Avg. Bars Held	8.00	8.00	N/A
Max. Consecutive	1	1	0
Largest loss	-461.06	-461.06	0.00
# bars in largest loss	8	8	0

Figure 3.3 -- Statistics

Discussion

The code includes a variable that represents direction. If a long position is taken as the price is rising, that is trend following. If a long position is taken as the price is falling, that is mean reverting. So the program represents two different trading systems and gives us the opportunity to

test and compare trend following (when Direction is 1) and mean reversion (when Direction is 0) in the same run.

The default optimizer is exhaustive, so all possible combinations were tested. (AmiBroker also supports non-exhaustive optimizations / searches, and these will be used in later examples to reduce execution time.)

980 combinations of parameter values were tested for rising prices, and 980 for falling.

All of the best alternatives shown in Figure 3.1 have a Direction of 0, meaning take a long position after a sequence of falling prices — a mean reversion system.

Buying when prices have been rising is trend following. 164 of the trend following alternatives showed a net profit, 816 showed a net loss. The best trend following system had parameters of 1, 1, 7, 0.6. It entered a long position after a single rising day, took profit at 0.6%, and exited on day 7.

Figure 3.4 shows the equity chart and drawdown chart for the best trend following system. Compare with Figure 3.2, which shows the same information for the best mean reversion system.

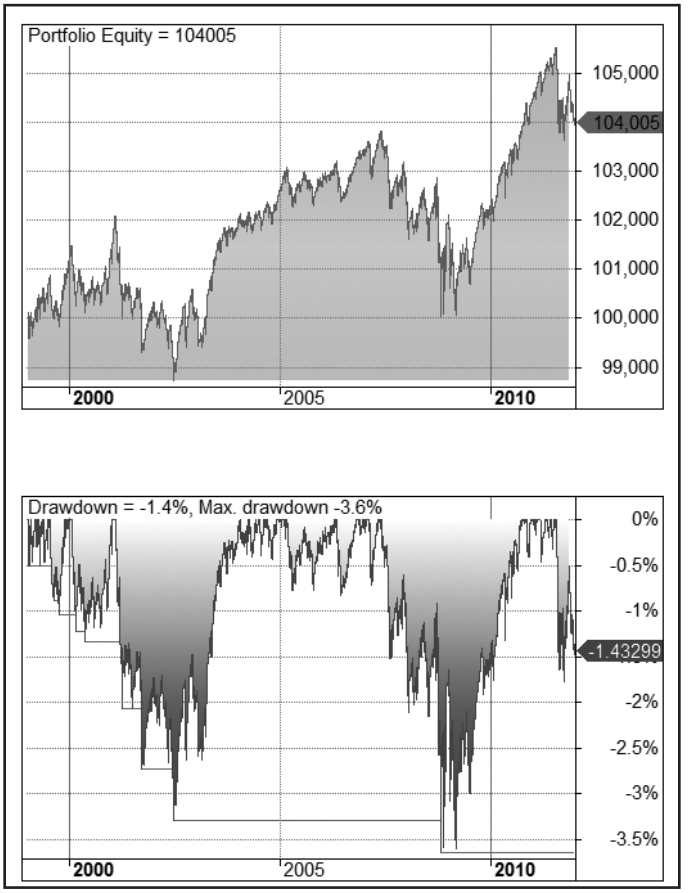


Figure 3.4 Best trend following system

Buying when prices have been falling is mean reverting. 912 of the mean reverting alternatives showed a net profit, 68 were not profitable.

Validation

Having 93% of the alternatives tested profitable shows that the system is fairly robust. But these results come from testing all available data. No data was reserved for out-of-sample testing, which is generally a poor practice and over estimates profit and under estimates risk. In later studies better validation techniques, including walk forward testing, will be used.

These tests suggest that SPY has been mean reverting over the recent past. Expanding the date range to include the entire history of SPY (in a study not shown here), it has been mean reverting since it was originally published in 1993 and continues to be in summer 2012.

We can test the system using other tradable issues. There is no guarantee that every system will work for every issue, nor is there a requirement that it must. But it is interesting and valuable to know which issues tend to be mean reverting and which tend to be trend following.

Two watchlists have been prepared and will be used for cross-tradable testing throughout this book.

One is a list of 14 highly liquid ETFs:

SPY	QQQ	IWM	EEM
GLD	XLB	XLE	XLF
XLI	XLK	XLP	XLU
XLV	XLY		

The other is a list of 32 issues that meet two criteria:

- They are highly liquid. They are among the 100 most liquid issues as of 2012.
- Their price as of 1/1/2012 is within a few percent of their price 1/1/1999. Their net buy and hold performance for 13 years is roughly flat — there is no bias to being long or short over that period.

They are a mixture of ETFs and common stocks. Their ticker symbols are:

AEP	DELL	IVV	SMH
ALL	DIS	KO	SPY
BAC	EWJ	MRK	T
BA	F	MS	TWX
CMCSA	GE	MSFT	VZ
COF	HD	PFE	WY
CSCO	HNZ	QQQ	XLU
DD	INTC	RTN	XLV

The 3, 0, 7, 0.4 values found when studying SPY were used to test these two groups. Figure 3.5 shows the results of trading each issue alone, sorted by CAR/MDD. 36 of the 42 issues were profitable. None of the 6 unprofitable issues had serious losses, and even those 6 had winning trade percentages in the high 80 percent range.

Ticker	CAR...	Net Profit	Net % Profit	Max. Sys % Drawdown	K-Ratio	# Trades	Avg Profit/Loss	Avg % Profit/Loss	% of Winners	Avg Bars Held
SPY	0.97	9,640.55	9.64	-0.74	0.0993	207	46.57	0.47	95.17	2.65
MSFT	0.81	10,232.41	10.23	-0.92	0.0771	230	44.49	0.44	93.91	2.64
QQQ	0.53	11,254.72	11.25	-1.56	0.0426	203	55.44	0.55	95.57	2.49
CMCSA	0.49	11,065.57	11.07	-1.66	0.0806	242	45.73	0.46	96.28	2.46
MS	0.38	16,094.66	16.09	-3.06	0.0392	260	61.90	0.62	92.69	2.72
PFE	0.38	7,471.77	7.47	-1.46	0.0474	224	33.36	0.33	91.07	2.88
EWJ	0.28	6,466.12	6.47	-1.74	0.0411	179	36.12	0.36	87.15	3.22
XLV	0.23	5,149.15	5.15	-1.66	0.0525	190	27.10	0.27	89.47	3.07
XLK	0.23	6,422.80	6.42	-2.11	0.0321	201	31.95	0.32	92.04	2.78
VZ	0.22	4,806.60	4.81	-1.63	0.0437	206	23.33	0.23	89.32	2.90
INTC	0.21	7,448.68	7.45	-2.59	0.0186	231	32.25	0.32	92.64	2.65
MRK	0.21	3,529.75	3.53	-1.26	0.0369	217	16.27	0.16	91.24	2.90
XLF	0.20	7,574.72	7.57	-2.83	0.0717	206	36.77	0.37	94.17	2.79
GE	0.20	5,830.88	5.83	-2.22	0.0444	223	26.15	0.26	92.83	2.81
IVV	0.18	4,194.40	4.19	-1.78	0.0414	164	25.58	0.26	91.46	3.12
XLY	0.18	6,821.97	6.82	-2.83	0.0299	214	31.88	0.32	91.12	3.08
HNZ	0.17	3,186.34	3.19	-1.39	0.0532	196	16.26	0.16	88.78	3.14
T	0.14	5,587.63	5.59	-2.94	0.0252	211	26.48	0.26	91.00	2.99
GLD	0.13	2,886.50	2.89	-1.72	0.0177	88	32.80	0.33	90.91	3.09
EEM	0.12	2,915.36	2.92	-1.88	0.0252	108	26.99	0.27	89.81	3.15
BK	0.12	4,996.51	5.00	-3.17	0.0192	221	22.61	0.23	91.86	2.90
IWM	0.12	4,252.58	4.25	-2.79	0.0262	177	24.03	0.24	92.66	2.86
HD	0.12	4,611.44	4.61	-2.79	0.0417	232	19.88	0.20	94.40	2.67
XLP	0.11	2,626.53	2.63	-1.80	0.0292	148	17.75	0.18	87.16	3.19
F	0.08	5,670.83	5.67	-5.31	0.0254	230	24.66	0.25	91.74	2.73
SMH	0.07	3,326.79	3.33	-3.72	0.0207	219	15.19	0.15	93.15	2.67
COF	0.07	3,243.73	3.24	-3.70	0.0152	230	14.10	0.14	91.74	2.77
XLU	0.06	2,006.59	2.01	-2.52	0.0233	181	11.09	0.11	90.06	2.92
DELL	0.06	2,284.32	2.28	-3.01	0.0144	208	10.98	0.11	90.38	2.90
DD	0.06	2,434.56	2.43	-3.08	0.0130	228	10.68	0.11	90.79	2.76
XLE	0.06	2,129.36	2.13	-2.69	0.0350	187	11.39	0.11	89.30	2.87
ALL	0.05	2,159.10	2.16	-3.30	0.0081	202	10.69	0.11	90.10	2.98
KO	0.04	1,767.71	1.77	-3.58	-0.0007	197	8.97	0.09	87.82	3.27
CSCO	0.03	2,570.11	2.57	-6.06	0.0108	201	12.79	0.13	92.54	2.77
DIS	0.02	1,164.32	1.16	-4.66	0.0065	212	5.49	0.05	91.51	2.89
XLI	0.00	5.94	0.01	-2.52	0.0074	178	0.03	0.00	86.52	3.17
AEP	-0.02	-1,542.10	-1.54	-7.17	-0.0017	207	-7.45	-0.07	89.86	2.91
TWX	-0.02	-1,367.36	-1.37	-5.53	-0.0233	253	-5.40	-0.05	87.75	3.08
WY	-0.02	-1,405.86	-1.41	-6.73	-0.0218	226	-6.22	-0.06	90.27	2.88
RTN	-0.03	-4,401.83	-4.40	-10.37	0.0060	205	-21.47	-0.21	89.27	3.06
BAC	-0.03	-3,661.21	-3.66	-11.05	-0.0189	221	-16.57	-0.17	88.69	2.87
XLB	-0.05	-2,929.34	-2.93	-4.94	-0.0117	194	-15.10	-0.15	86.60	3.11

Figure 3.5 -- Naive mean reversion results

Comparison with ideal trend following

Returning to analysis of SPY, it is interesting to compare the naive mean reversion system to some ideal trend following systems.

The zigzag indicator uses a single numerical argument — the minimum percentage change between peaks and valleys. Applied to closing prices, a zigzag of a certain percentage, say 5%, forms a series of trends where every upward or downward segment is at least 5% and has no retracements greater than 5%. If a system had perfect knowledge of future prices, it could identify the zigzag bottoms as they were being formed. Assume such a system took a long position on the close of the first day following a bottom, then sold using the same holding period and profit target rules as the naive mean reversion system. The percentage was adjusted until the number of trades and percentage exposure of the

ideal zigzag system roughly matched that of the naive mean reversion systems. A zigzag percentage of 1.80% was selected. Figure 3.6 shows the equity curve and drawdown curve for the result.

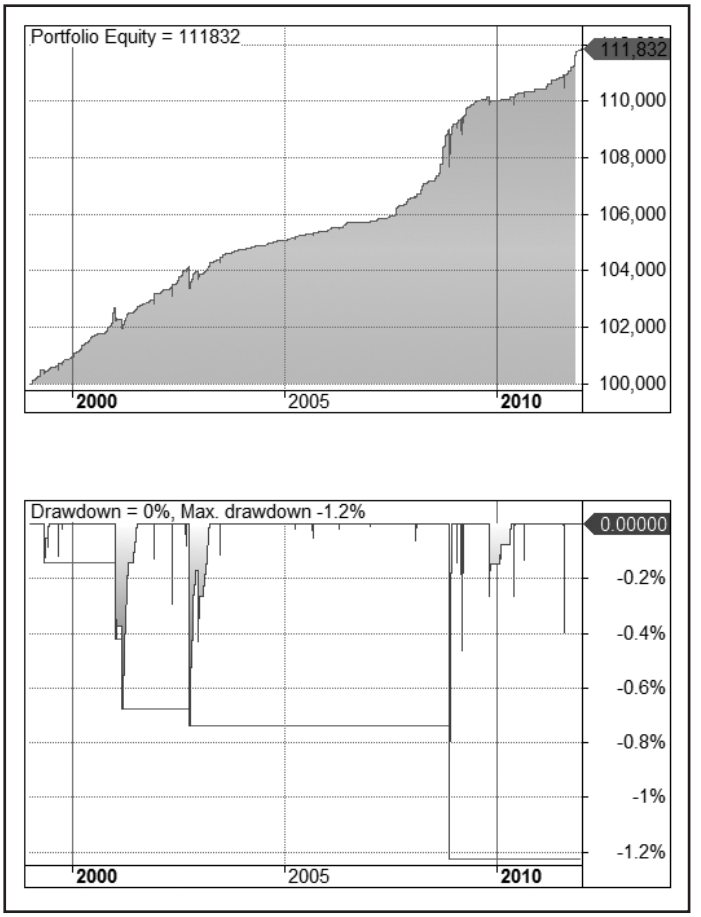
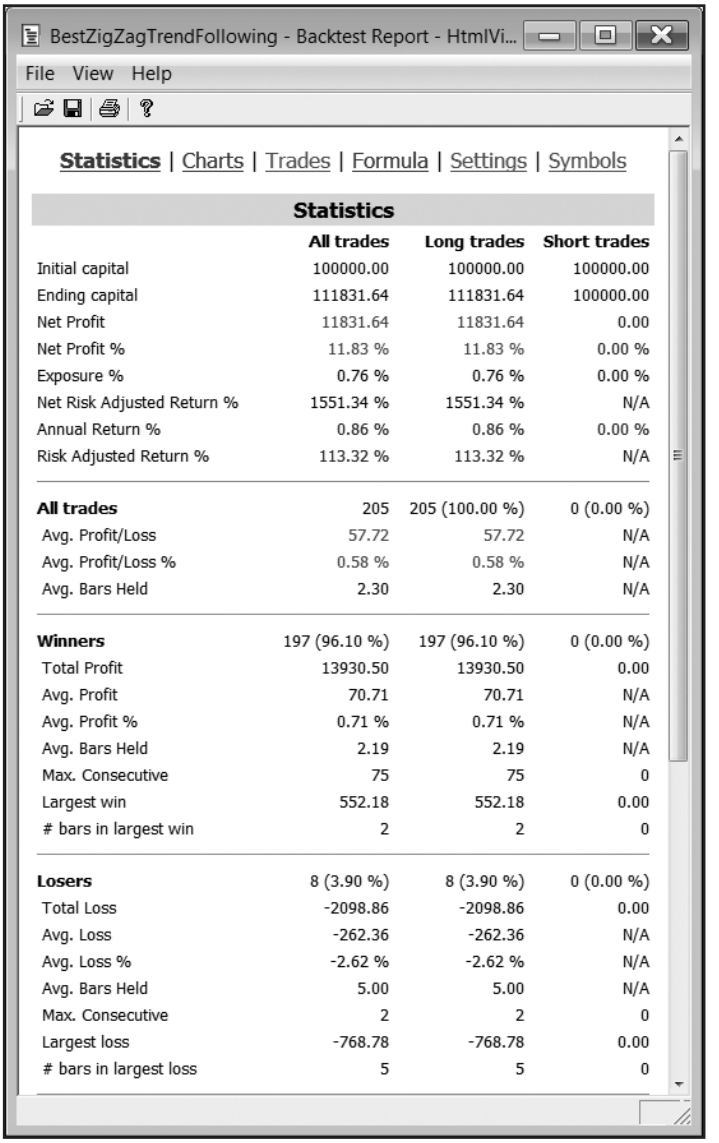


Figure 3.6 -- Equity curve for perfect trend following system

Figure 3.7 shows the summary statistics.



Statistics

	All trades	Long trades	Short trades
Initial capital	100000.00	100000.00	100000.00
Ending capital	111831.64	111831.64	100000.00
Net Profit	11831.64	11831.64	0.00
Net Profit %	11.83 %	11.83 %	0.00 %
Exposure %	0.76 %	0.76 %	0.00 %
Net Risk Adjusted Return %	1551.34 %	1551.34 %	N/A
Annual Return %	0.86 %	0.86 %	0.00 %
Risk Adjusted Return %	113.32 %	113.32 %	N/A
All trades	205	205 (100.00 %)	0 (0.00 %)
Avg. Profit/Loss	57.72	57.72	N/A
Avg. Profit/Loss %	0.58 %	0.58 %	N/A
Avg. Bars Held	2.30	2.30	N/A
Winners	197 (96.10 %)	197 (96.10 %)	0 (0.00 %)
Total Profit	13930.50	13930.50	0.00
Avg. Profit	70.71	70.71	N/A
Avg. Profit %	0.71 %	0.71 %	N/A
Avg. Bars Held	2.19	2.19	N/A
Max. Consecutive	75	75	0
Largest win	552.18	552.18	0.00
# bars in largest win	2	2	0
Losers	8 (3.90 %)	8 (3.90 %)	0 (0.00 %)
Total Loss	-2098.86	-2098.86	0.00
Avg. Loss	-262.36	-262.36	N/A
Avg. Loss %	-2.62 %	-2.62 %	N/A
Avg. Bars Held	5.00	5.00	N/A
Max. Consecutive	2	2	0
Largest loss	-768.78	-768.78	0.00
# bars in largest loss	5	5	0

Figure 3.7 -- Statistics for perfect trend following system

Extension of mean reversion system

Continuing analysis of the mean reversion system based on a sequence of days with falling prices, Figure 3.8 shows a chart of SPY for a six month period in 2011 with upward arrows below the bars that complete a sequence of three falling days. The system described takes a single

position at the first occurrence of three falling days. There are times when a long position has not been closed, but additional falling days would cause additional signals. See Figure 3.8 and the multiple arrows in the circled bars.

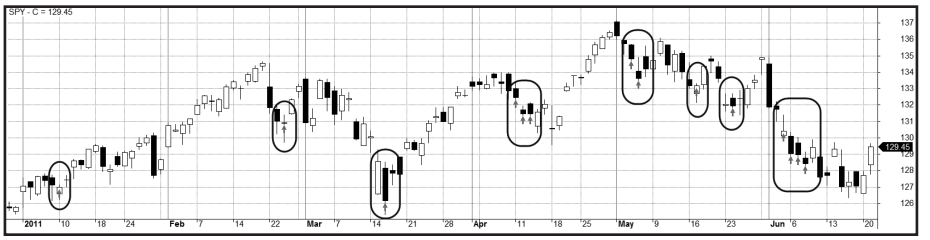


Figure 3.8 -- Signals for entries using 3 falling days

Figure 3.9 shows the trade results, based on the sequence of three falling days, for the period in Figure 3.8.

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position ...	Cum. Profit	# bars	Profit/b...	MAE	MFE
SPY	Long (profit)	1/10/2011	126.98	1/11/2011	127.488	0.40%	40.00	0.40%	78.7526	10,000.00	8,102.90	2	20.00	-0.61%	0.40%
SPY	Long (profit)	2/24/2011	130.93	2/25/2011	131.48	0.42%	42.01	0.42%	76.3767	10,000.00	8,144.91	2	21.00	-0.94%	0.42%
SPY	Long (profit)	3/16/2011	126.18	3/17/2011	128	1.44%	144.24	1.44%	79.2519	10,000.00	8,289.14	2	72.12	-0.71%	1.89%
SPY	Long (n-bar)	4/11/2011	132.46	4/20/2011	133.1	0.48%	48.32	0.48%	75.4945	10,000.00	8,337.46	8	6.04	-2.23%	0.75%
SPY	Long (profit)	5/4/2011	134.83	5/6/2011	135.369	0.40%	40.00	0.40%	74.1675	10,000.00	8,377.46	3	13.33	-1.34%	0.67%
SPY	Long (profit)	5/17/2011	133.17	5/18/2011	133.703	0.40%	40.00	0.40%	75.092	10,000.00	8,417.46	2	20.00	-0.79%	0.40%
SPY	Long (profit)	5/24/2011	131.95	5/25/2011	132.478	0.40%	40.00	0.40%	75.7863	10,000.00	8,457.46	2	20.00	-0.19%	0.59%
SPY	Long (n-bar)	6/3/2011	130.42	6/14/2011	129.32	-0.84%	-84.34	-0.84%	76.6754	10,000.00	8,373.12	8	-10.54	-2.58%	0.77%

Figure 3.9 -- Trade list for signals using 3 falling days in Figure 3.8

The program was modified so that entries required a sequence of 4, 5, and 6 falling days, and a backtest was performed for each. Figures 3.10, 3.11, and 3.12 show the trades for those systems, respectively, for the period covered in Figure 3.8.

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position ...	Cum. Profit	# bars	Profit/b...	MAE	MFE
SPY	Long (profit)	4/12/2011	131.47	4/13/2011	132.08	0.46%	46.40	0.46%	76.063	10,000.00	2,961.57	2	23.20	-0.37%	0.46%
SPY	Long (profit)	5/5/2011	133.61	5/6/2011	134.94	1.00%	99.54	1.00%	74.8447	10,000.00	3,061.11	2	49.77	-0.44%	1.00%
SPY	Long (profit)	6/6/2011	129.04	6/7/2011	129.7	0.51%	51.15	0.51%	77.4954	10,000.00	3,112.26	2	25.57	-0.13%	1.02%
SPY	Long (profit)	6/8/2011	128.42	6/9/2011	128.934	0.40%	40.00	0.40%	77.8695	10,000.00	3,152.26	2	20.00	-0.19%	0.60%

Figure 3.10 -- Trade list for 4 falling days

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position ...	Cum. Profit	# bars	Profit/b...	MAE	MFE
SPY	Long (profit)	4/13/2011	131.46	4/15/2011	131.986	0.40%	40.00	0.40%	76.0688	10,000.00	2,461.41	3	13.33	-0.91%	0.55%
SPY	Long (profit)	6/7/2011	128.96	6/9/2011	129.476	0.40%	40.00	0.40%	77.5434	10,000.00	2,501.41	3	13.33	-0.60%	0.86%

Figure 3.11 -- Trade list for 5 falling days

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position ...	Cum. Profit	# bars	Profit/b...	MAE	MFE
SPY	Long (profit)	6/8/2011	128.42	6/9/2011	128.934	0.40%	40.00	0.40%	77.8695	10,000.00	587.28	2	20.00	-0.19%	0.60%

Figure 3.12 -- Trade list for 6 falling days

These are seven additional trades that were not signaled by the original code. All seven were profitable.

Note that the trade entered on June 3 using the original 3 day sequence resulted in a loss of 0.84%. If longer sequences are recognized and multiple positions allowed, several additional trades would have been signaled. The four trades entered on June 6 and 8 from a 4 day sequence, June 7 using a 5 day sequence, and June 8 using a 6 day sequence resulted in a total gain of 1.71%, recovering from the 0.84% loss.

Figure 3.13 shows three equity and drawdown curves. They represent using 4, 5, and 6 day sequences of falling closing prices to enter a long trade, respectively.

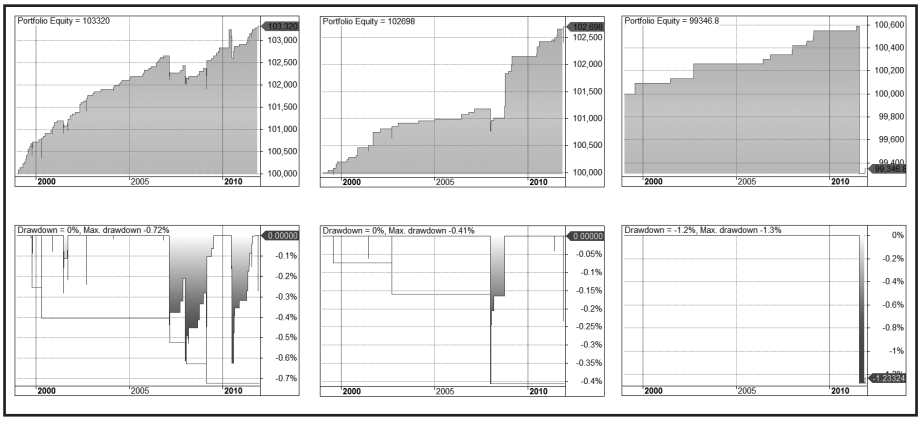


Figure 3.13 -- Equity curves for 4, 5, 6 day sequence

In my opinion, these should be treated as separate systems, not as "scaling-in." Each of the systems should be evaluated on its own merit.

The original code was modified to allow multiple positions and to enter on any sequence of three or more falling days. Figure 3.14 shows the resulting equity and drawdown curves.

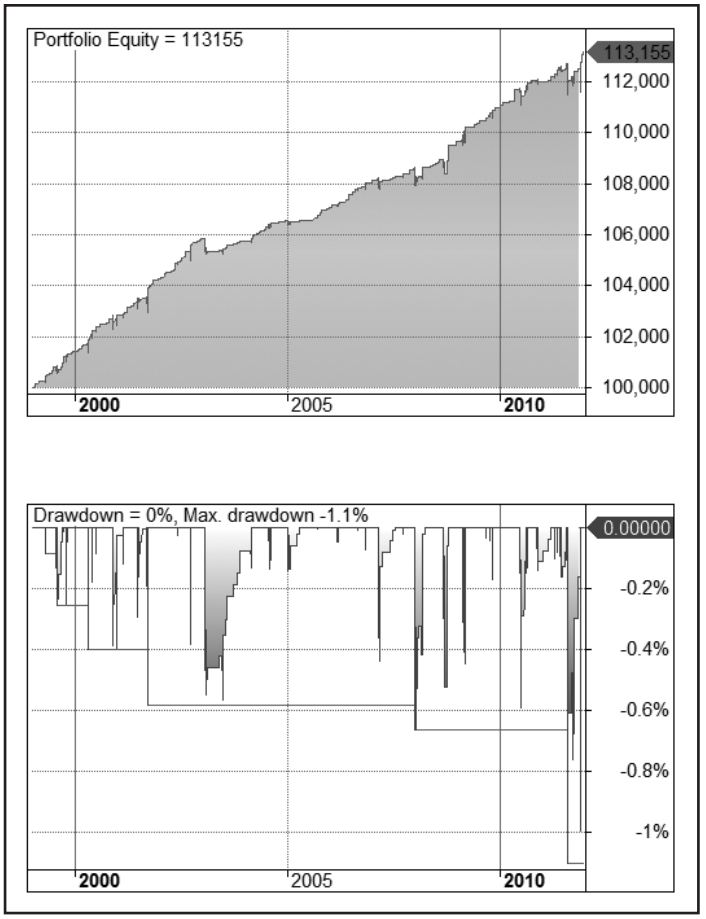
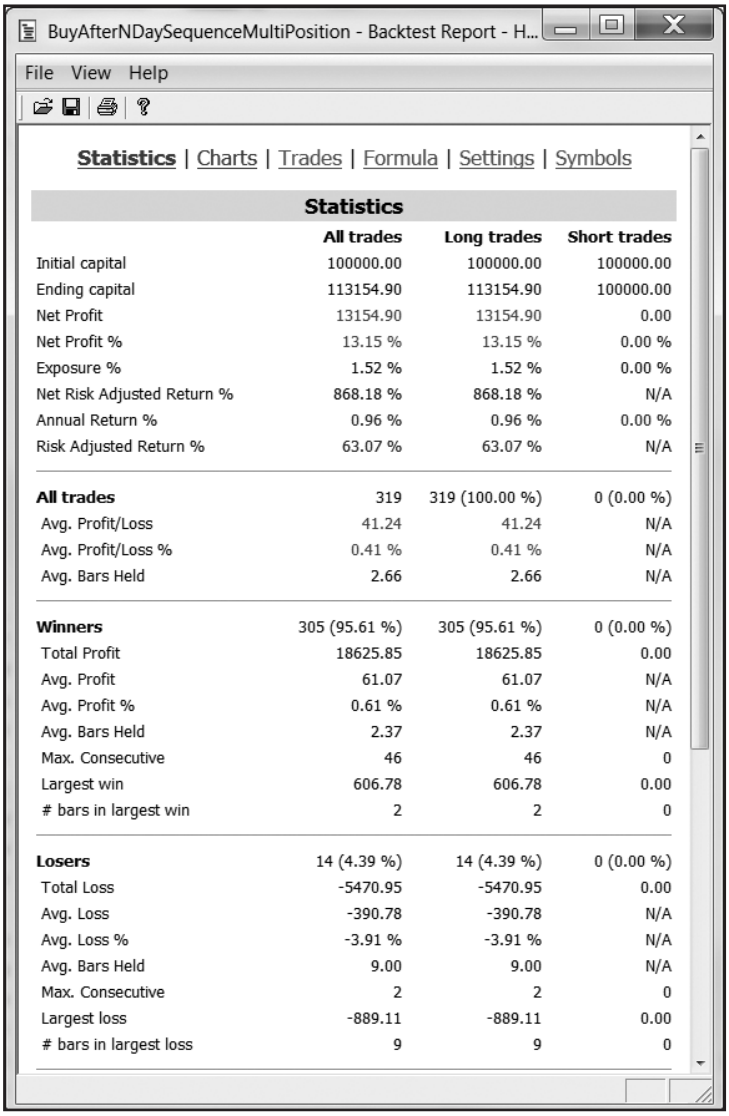


Figure 3.14 -- Equity curve allowing multiple positions

Figure 3.15 shows the associated statistics.



Statistics

	All trades	Long trades	Short trades
Initial capital	100000.00	100000.00	100000.00
Ending capital	113154.90	113154.90	100000.00
Net Profit	13154.90	13154.90	0.00
Net Profit %	13.15 %	13.15 %	0.00 %
Exposure %	1.52 %	1.52 %	0.00 %
Net Risk Adjusted Return %	868.18 %	868.18 %	N/A
Annual Return %	0.96 %	0.96 %	0.00 %
Risk Adjusted Return %	63.07 %	63.07 %	N/A
All trades	319	319 (100.00 %)	0 (0.00 %)
Avg. Profit/Loss	41.24	41.24	N/A
Avg. Profit/Loss %	0.41 %	0.41 %	N/A
Avg. Bars Held	2.66	2.66	N/A
Winners	305 (95.61 %)	305 (95.61 %)	0 (0.00 %)
Total Profit	18625.85	18625.85	0.00
Avg. Profit	61.07	61.07	N/A
Avg. Profit %	0.61 %	0.61 %	N/A
Avg. Bars Held	2.37	2.37	N/A
Max. Consecutive	46	46	0
Largest win	606.78	606.78	0.00
# bars in largest win	2	2	0
Losers	14 (4.39 %)	14 (4.39 %)	0 (0.00 %)
Total Loss	-5470.95	-5470.95	0.00
Avg. Loss	-390.78	-390.78	N/A
Avg. Loss %	-3.91 %	-3.91 %	N/A
Avg. Bars Held	9.00	9.00	N/A
Max. Consecutive	2	2	0
Largest loss	-889.11	-889.11	0.00
# bars in largest loss	9	9	0

Figure 3.15 -- Statistics allowing multiple positions

Listing 3.2 shows the AmiBroker code.

```
//   BuyAfterAnNDaySequenceMultiPosition.afl
//
```

```
SetOption( "ExtraColumnsLocation", 1 );
SetOption ( "CommissionMode", 2 ); // $ per trade
SetOption( "CommissionAmount", 0 );
SetOption( "InitialEquity", 100000 );
SetPositionSize( 10000, spsValue );
MaxPos = 7;
SetOption( "MaxOpenPositions", MaxPos );
SetBacktestMode( backtestRegularRawMulti );
SetTradeDelays( 0, 0, 0, 0 );
BuyPrice = Close;
SellPrice = Close;
//  ObFn == K-ratio, CAR/MDD, expectancy

//  Define a day as rising based on the closing price
Rising = C > Ref( C, -1 );
Falling = C < Ref( C, -1 );

// The number of days in the sequence
N = Optimize( "N", 3, 1, 7, 1 );

//  Direction.  1 == Rising, 0 == Falling
Direction = 0; // Optimize( "Direction", 0, 0, 1, 1 );

//  Exit variables
//  Maximum holding period
HoldDays = Optimize( "HoldDays", 4, 1, 7, 1 );
//  Profit target
ProfitTarget = Optimize( "ProfitTarget", 0.4, 0.2, 4, 0.2 );

//  Detect an N day sequence

if ( Direction == 1 )
{
    NDaySequence = Sum( Rising, N ) >= N;
}
else
{
    NDaySequence = Sum( Falling, N ) >= N;
}

Buy = NDaySequence;

Sell = 0;

ApplyStop( stopTypeProfit, stopModePercent, ProfitTarget );
ApplyStop( stopTypeNBar, stopModeBars, HoldDays );

//  Plots
Plot( C, "C", colorBlack, styleCandle );
shapes = IIf( Buy, shapeUpArrow, shapeNone );
shapecolors = IIf( Buy, colorGreen, colorWhite );
PlotShapes( shapes, shapecolors );

///////////////  end  ////////////////
```

Listing 3.2 -- N-Day Multiposition System

Extreme oversold

Look in particular at the large loss by the final trade in the 6 day sequence in Figure 3.13. While there are only 12 trades in the 13 year period signaled by a sequence of 6 falling days, too few to draw conclusions, it is often the case that the most extreme oversold conditions are poor entries. One colleague gave the analogy of taking a cold remedy -- one teaspoon helps, two teaspoons helps a lot, three teaspoons makes him worse.

Summary

We have discovered a simplistic, naive mean reversion system that could be traded. Its results are realistic and achievable. It is applicable to a wide range of tradable issues. Its results are roughly comparable to a nearly ideal trend following system that requires perfect knowledge of the future, giving us confidence that mean reversion systems are practical alternatives to trend following systems.

The remainder of this book expands development of mean reversion systems.