How to Build an Effective Trading System

(and Build Confidence that It Will Be Profitable)

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NAAIM 2008

Disclaimer

- This is an educational presentation
- The purpose is to explain the author's method for developing trading systems
- This is not a trading system presentation
- Neither the author and presenter, Howard Bandy, nor the conference organizer, NAAIM, is liable for losses resulting from application of techniques described in this presentation

The Problem

The Solution

Practical Implementation

The Problem

- Will the newly developed trading system be profitable when traded?
- How confident can we be?

The Solution

- In a word –
  - Practice
- In more detail –
  - Tomorrow is out-of-sample
  - Study simulated out-of-sample trades made by the system
  - Every transition from in-sample to out-of-sample increases our confidence
  - If the out-of-sample results are satisfactory, trade the system

Our Premises

- Mechanical systems
- Markets are somewhat inefficient
- We can detect patterns in historical data that precede profitable opportunities
- Those patterns persist long enough to make profitable trades

Lord Kelvin - 1891

“When you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind…”

Trading System Development

1. Define the objective function
2. Decide what to trade and how to trade it
3. Design the trading system
4. Determine the in-sample period
5. Determine the out-of-sample period
6. Decide what to optimize
7. Perform walk forward runs
8. Evaluate out-of-sample results
9. Trade the system
10. Monitor the results

Defining Best – Objective Function

- Psychology of trading experts have it backwards
- Cognitive dissonance
- Start by identifying what is important to you
- Create an objective function that incorporates those features
- Use this to compare alternative systems

Defining Best – Objective Function

- A function that gives single-valued score
- A measure of the system
- Incorporates important features
- Score is reported for every test run
- Will be used during walk forward
- You select the objective function
- Take your time and get it right
- Don’t start designing and testing without it

What is Important?

- Drawdown
- Annual percentage gain
- Holding period
- Trading frequency
- Exposure
- Expectancy
- Equity smoothness
- Percent winners
- Win to loss ratio
- Recovery
- Thoughts from the audience

Drawdown

- In a single trade, it is the maximum amount of loss at any time, relative to the best price
- In a system, it is the maximum decline in the account's equity at any time, measured from maximum equity up to that point
- Drawdown is probably the single most important metric – excessive drawdown is the most common reason traders stop using a system
- Given a smooth equity curve, add leverage as desired to the point where drawdown becomes limiting

Expectancy

- Expectancy is the amount or percentage that is gained or lost by the average trade
- Expectancy = % winners * average profit per win + % losers * average loss per loss
- Expectancy must be positive
- No money management scheme can turn a system with negative expectancy into a winning system
- Poor money management can turn any system into a losing system

Objective Function Choices

- Net Profit
  - Often the default
  - Usually a poor choice
- Reward equity growth and equity smoothness
- Penalize drawdowns
- Examples:

K-ratio	CAR/MDD
Ulcer Performance Index	RAR/MDD

Good Objectives

- Specific; Measurable; Realistic

- “My goal is to make a 15% annual profit trading common stocks, control drawdowns, cherry-pick trades, hold about one week, and be tradable without interfering with my day job.”

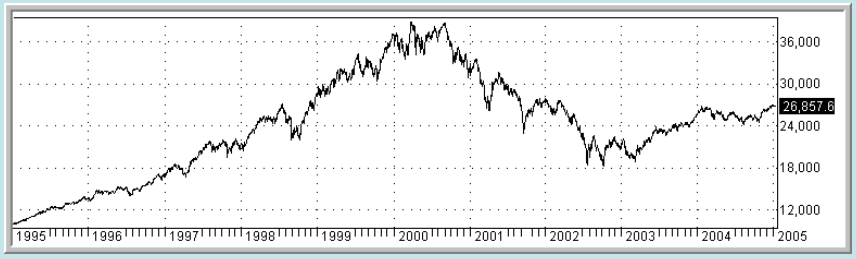
Translated

- Compound Annual Return > 15%
- Maximum System Drawdown < 15%
- Exposure ~ 30%
- Holding 3 to 7 days
- Use end-of-day data
- Evaluate in the evening
- Trade Market on Open

Verify Your Objective Function

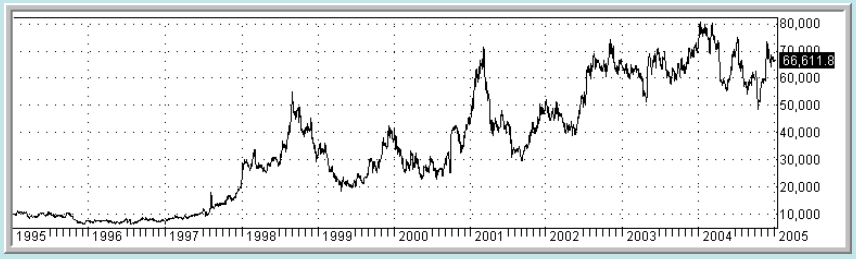
- Choose metrics that best fit your trading style and personality
- Run some optimizations
- Plot the equity curves of several variations
- Sort the results into order by ObFn
- You should prefer them in order by ObFn
- If not, modify the objective function until they are ranked correctly
- Will be used during walk forward

Typical Equity Curves

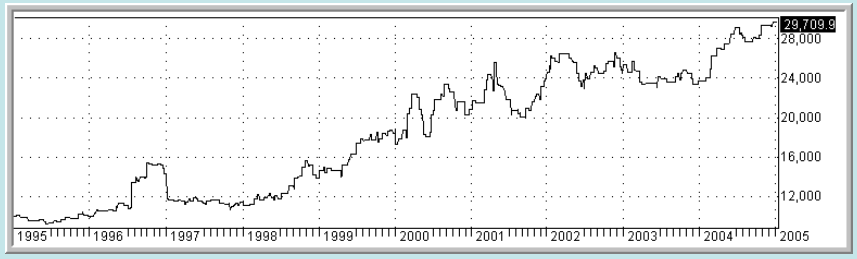


Buy and Hold

Breakout



Reversal



Cherry Pick

Data and Issues

- Historical data for backtesting
- Current data for trading
- Liquidity
- Price reasonable
- Data cleanliness
  - Bad quotes
  - Unadjusted splits, distributions, restatements
  - Visual inspection
  - Consistency

About Financial Data

- It is non-stationary
  - Cannot be made stationary
  - Autocorrelation is very weak
- Data = trends + cycles + patterns + noise
- Trading system is designed to recognize some signal portion
- Low signal to noise ratio
- Noise is everything the system does not model

How to Trade

- End-of-day, intraday
- MOO, MOC, limit orders, stops

- Single issues
- Portfolios

- Position size
- Risk management

Models and Modeling

1. Build a model
   - Trial and error
   - Deduction (reasoning)
   - Induction (analysis of data)
   - Loop of
     - Conjecture
     - Experiment
     - Observe
     - Modify
2. Validate that the model represents signal, not noise (out-of-sample testing)
3. Monitor to determine whether the model and the underlying are in sync (statistical tests)

Models and Reality

- Our trading models are static
- The reality we are trying to model is dynamic
- Our hope:
  - We can build a model of the data,
  - That recognizes some inefficiency,
  - And use that model to trade profitably,
  - As long as the model and reality stay in sync.

What to Model – Something Easy

- Sector ETFs
- Sector Mutual Funds
- Indices
- Industry Monitor ID Groups
- Custom Indices (AddToComposite)
- Beware survivor bias

Survivor Bias

- Companies that fail disappear
- Mergers and acquisitions change the characteristics of companies
- Companies currently in a list, group, fund, industry, or index may not have always been there
- Others that used to be members may be missing

What to Trade – Something Profitable and Liquid

- Stocks, funds, ETFs, futures
- Single issue
- Portfolio
- Model one thing – trade another

Liquidity

- $100M per day
  - 500 issues
  - 300 of the S&P500
  - $0.01 – $0.02 spread
  - Very few gaps on 1 minute chart
- $20M per day
  - 1500 issues
  - $0.01 - $0.04 spread

50 Most Liquid Issues

Ticker	Date/Time	Liquidity
SPY	1/25/2008	37,112,352,768
QQQQ	1/25/2008	9,951,163,392
AAPL	1/25/2008	9,467,742,208
IWM	1/25/2008	8,113,359,872
EEM	1/25/2008	4,033,025,280
GOOG	1/25/2008	4,032,880,128
XLF	1/25/2008	3,451,907,584
C	1/25/2008	3,276,669,440
MSFT	1/25/2008	2,844,540,672
RIMM	1/25/2008	2,800,754,176
DIA	1/25/2008	2,586,996,736
BIDU	1/25/2008	2,570,369,536
XOM	1/25/2008	2,460,446,976
INTC	1/25/2008	2,372,244,224
GS	1/25/2008	2,351,161,344
XLE	1/25/2008	2,021,823,744
BAC	1/25/2008	1,979,942,400
CSCO	1/25/2008	1,759,962,240
GE	1/25/2008	1,740,475,648
QID	1/25/2008	1,677,708,544
SDS	1/25/2008	1,583,930,368
FXI	1/25/2008	1,558,116,736
JPM	1/25/2008	1,536,514,048
OIH	1/25/2008	1,492,351,872
MER	1/25/2008	1,492,062,976

Ticker	Date/Time	Liquidity
T	1/25/2008	1,327,251,584
FCX	1/25/2008	1,281,904,768
EWZ	1/25/2008	1,280,348,800
FSLR	1/25/2008	1,275,334,272
SLB	1/25/2008	1,230,756,480
WMT	1/25/2008	1,218,315,520
IBM	1/25/2008	1,196,087,680
COP	1/25/2008	1,193,484,288
EFA	1/25/2008	1,163,523,712
PFE	1/25/2008	1,163,429,632
CVX	1/25/2008	1,146,711,424
WFC	1/25/2008	1,109,311,104
MO	1/25/2008	1,078,918,784
MON	1/25/2008	1,073,577,600
RIG	1/25/2008	1,072,584,064
MRK	1/25/2008	1,054,499,648
WB	1/25/2008	1,038,890,496
AIG	1/25/2008	1,026,049,856
JNJ	1/25/2008	1,014,584,960
POT	1/25/2008	1,006,471,808
GLD	1/25/2008	999,926,336
HPQ	1/25/2008	995,904,192
ORCL	1/25/2008	974,322,944
MDY	1/25/2008	973,041,088
QCOM	1/25/2008	969,858,496

Daily average dollar volume for 20 days in early 2008

Profitability

- Model XLF
  - Run ZigZag.afl to see potential
- Trade components
  - Use WatchList XLFComponents
  - Run XLFComponents.afl to see potential
- XLF is easier to model
- The components are more profitable to trade

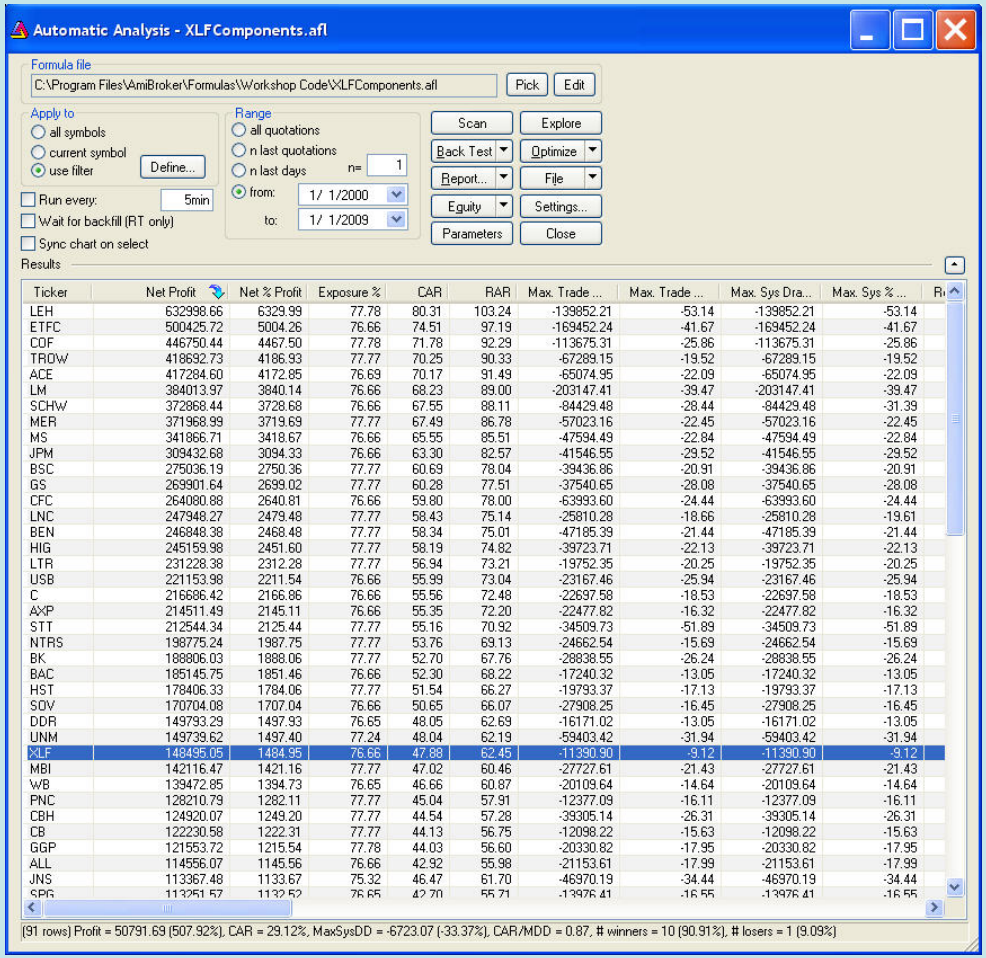
XLF ZigZag


XLF - C = 37.29, Z = 37.29
37.29
36.0
32.0
28.0
24.0
20.0
2000
2001
2002
2003
2004
2005
2006
2007

XLFComponents.afl

```
// XLFComponents.afl
//
// This AmiBroker program uses the ZigZag function
// to give perfect buy and sell signals based on the
// S&P Sector, XLF.
//
// To use this system,
// 1. Analysis >> Automatic Analysis
// 2. Pick >> select ZigZag.afl >> Open
// 3. Set the Watchlist to XLFComponents
// 4. Back test >> Individual Backtest
//
// Note that about half the components are
// more profitable than XLF itself when traded
// using the signals computed from the XLF data.
//

// Take signals from the ticker XLF
SetForeign("xlf");

// Analyze using the Closing price
PricePoint = C;

// Set the ZigZag Percentage
Percentage = 10;

Z = Zig(PricePoint,Percentage);
Buy = Z<=Ref(Z,1) AND Z<=Ref(Z,-1);
Sell = Z>=Ref(Z,1) AND Z>=Ref(Z,-1);
Short = Sell;
Cover = Buy;

RestorePriceArrays();

// Take trades on tickers in watchlist.

Plot(C,"C",colorBlack,styleCandle);
PlotShapes(shapeUpArrow*Buy,colorBrightGreen);
PlotShapes(shapeDownArrow*Sell,colorRed);
Plot(Z,"Z",colorRed,styleLine|styleOwnScale);
```

Trading XLF Components



Creating a system

- A model is a combination of:
  - One or more entry methods
  - One or more exit methods
- A trading system is a combination of:
  - One or more models
  - One or more data series

  that, together, give buy and sell signals for some tradable issue or portfolio.

Types of Systems

- Trend following
  - Breakout
  - Moving average
- Mean reversion
- Pattern
- Seasonality
- Cycle
- Others?

- Every trade is a trend-following trade while you are in it

Entries

- Signals
  - Indicators
  - Patterns
  - Seasonality
  - Cycles
- Setups
- Filters
- Random – for comparison

Exits

- Signals – Indicators, patterns, seasonality, cycles
  - Same as entry – other direction
  - Same logic – different parameter values
  - Different logic
- Timed holding period
- Profit target
- Trailing stop
- Maximum loss stop

Indicator Exits

- Indicators introduce lag
- No need to be symmetric
- Rises look different than falls

Stops are Not Reasons to Sell

- Best exits come from signals and indicators
- Mean reversion (short holding periods) – profit targets and timed holding periods
- Trend following (longer holding periods) – trailing stops
- Maximum loss stop is for emergency protection only
- Stops hurt systems

Short Holding Periods

- Advantages:
  - Drawdown increases as square root of holding period
  - Allows selective trading
  - Gives many trading opportunities
  - Tighter distribution of trade results
  - More data points for statistics

Short Holding Periods

- Disadvantages:
  - Increased trading
  - Higher commissions
  - Tax consequences
  - Fund restrictions
  - Portfolio restrictions

Terminal Relative Wealth

- The value of a trading account after some time, expressed as a ratio to its starting value
- Depends on exactly two numbers:
- $TRW = (1+e)^n$

  e == expectancy as a decimal fraction

  n == number of trades

- (Drawdowns may vary considerably)

Code Signals First, Then Stops

- Begin by coding your entry
- If you use more than one entry, test each separately
- Add your exit using logic appropriate for the type of system
- If you use more than one exit, test each separately
- Add stops only for protection

Reality Check

- Be certain the system is tradable
  - All the data is available when you need it
  - There is enough time to compute signals
  - Assumptions about liquidity and slippage are realistic
  - No future leak

Brains? Or Bull Market?

- Beware of long-only systems in strong bull markets
- Safeguards:
  - Look for profitable shorts
  - Look at periods or tickers when price is flat or falling

Simulated Trading

- An automated series of:
  1. Evaluate alternatives in-sample
  2. Select the best alternative
  3. Simulate trading out-of-sample
- Move forward in time and repeat steps 1, 2, and 3
- If out-of-sample results are satisfactory, trade the system

In-Sample

- In-sample – the period of time (and the data and trades associated with it) where the alternatives of logic and parameter values are evaluated
- In-sample results are always good
- In-sample results have no value in estimating the future performance of the system

Out-of-Sample

- Out-of-sample – the period of time (and the data and trades associated with it) where the trading system is tested on data it has never seen before
- Immediately follows the in-sample period
- Caution – making decisions based on out-of-sample data results in that data becoming part of the in-sample data

In-sample – Out-of-sample

In-sample Period Length

- How long should the in-sample period be?
- Opinions include:
  - A long time period

    Pro: Include many different conditions

    Con: Cannot accurately model everything
  - A short time period

    Pro: Stay synchronized with current conditions

    Con: Learn noise instead of signal
- Experiment
- My recommendation – as short as practical

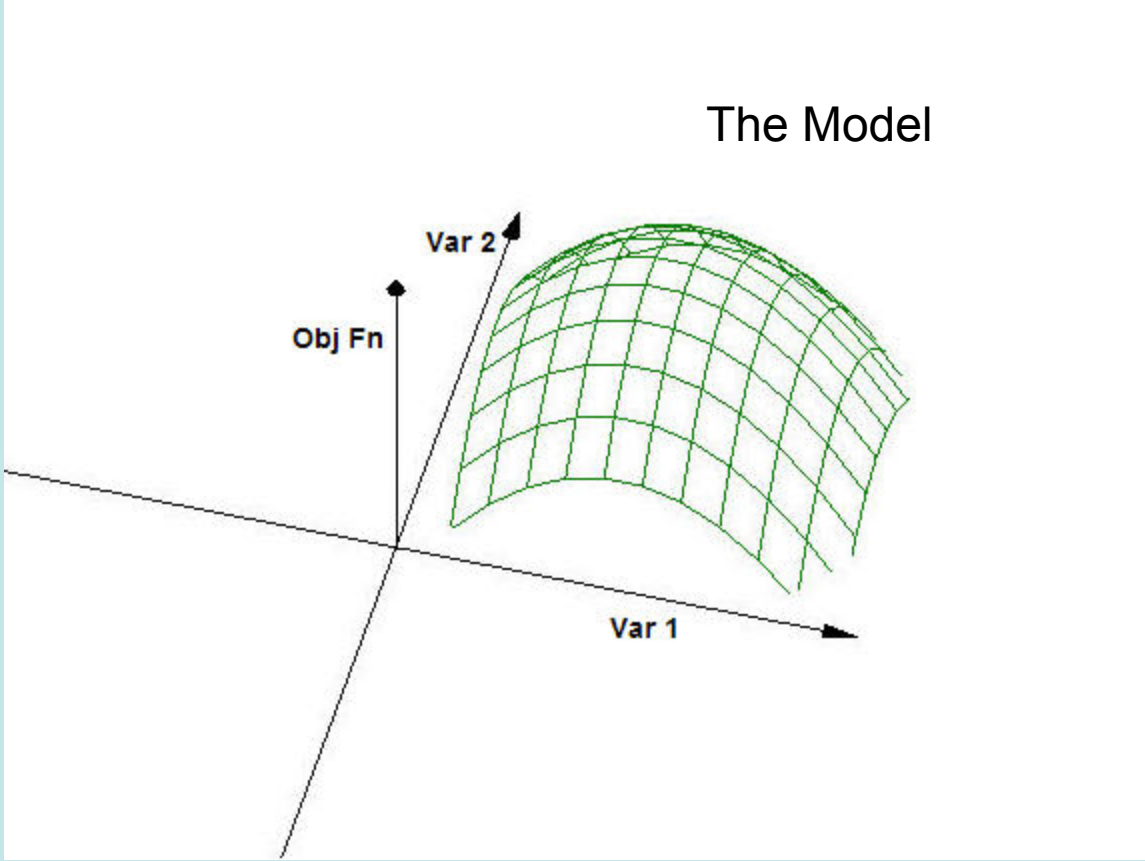
Out-of-Sample Period Length

- As long as the model and the market remain in sync
- Unrelated to length of in-sample period

Optimization

- A search for the best values for logic and parameters
- Any time two or more alternatives are considered, you might as well consider thousands
- Rough runs to determine ranges
- Thorough runs to locate maxima

Which Way is Up?



How to Optimize

- One dimension at time
  - Takes less time
  - Can get stuck
  - Finds local maxima
- Multiple dimensions
  - Exhaustive search
  - Long runs
  - Detect interactions and global maxima
- Use preliminary runs to select the range

Reoptimization

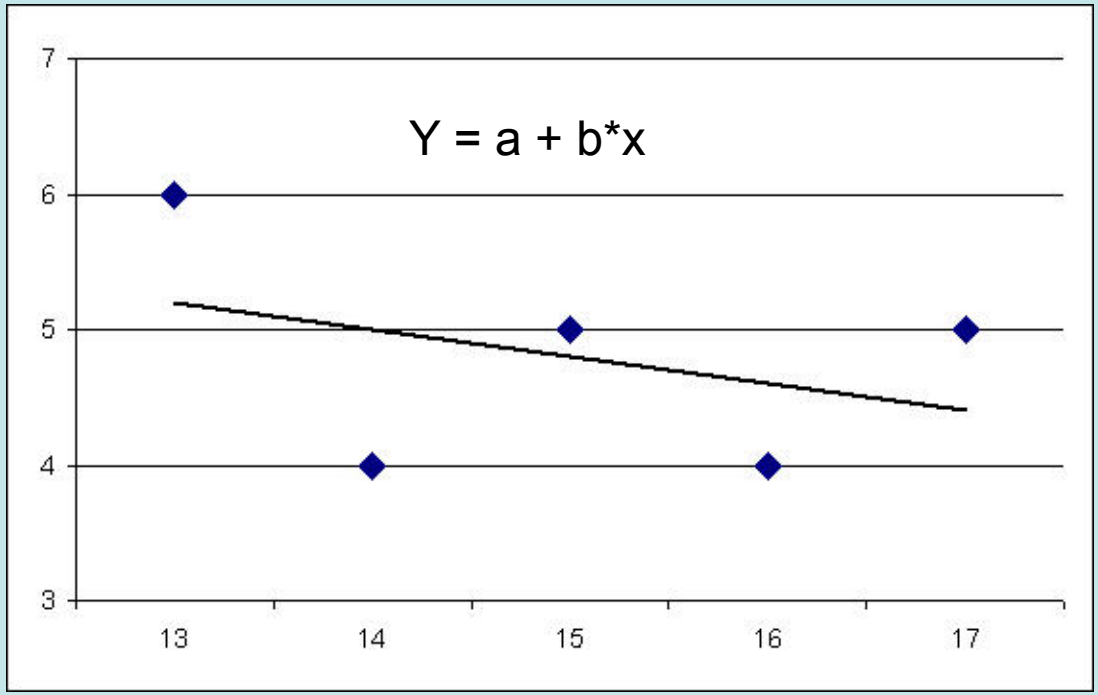
- Length of out-of-sample period determines reoptimization schedule
- You may reoptimize at any time

Degrees of Freedom

- Every data point contributes one degree of freedom
- Every alternative considered uses up one degree of freedom
- Curve-fit or over-fit means there are no degrees of freedom left over

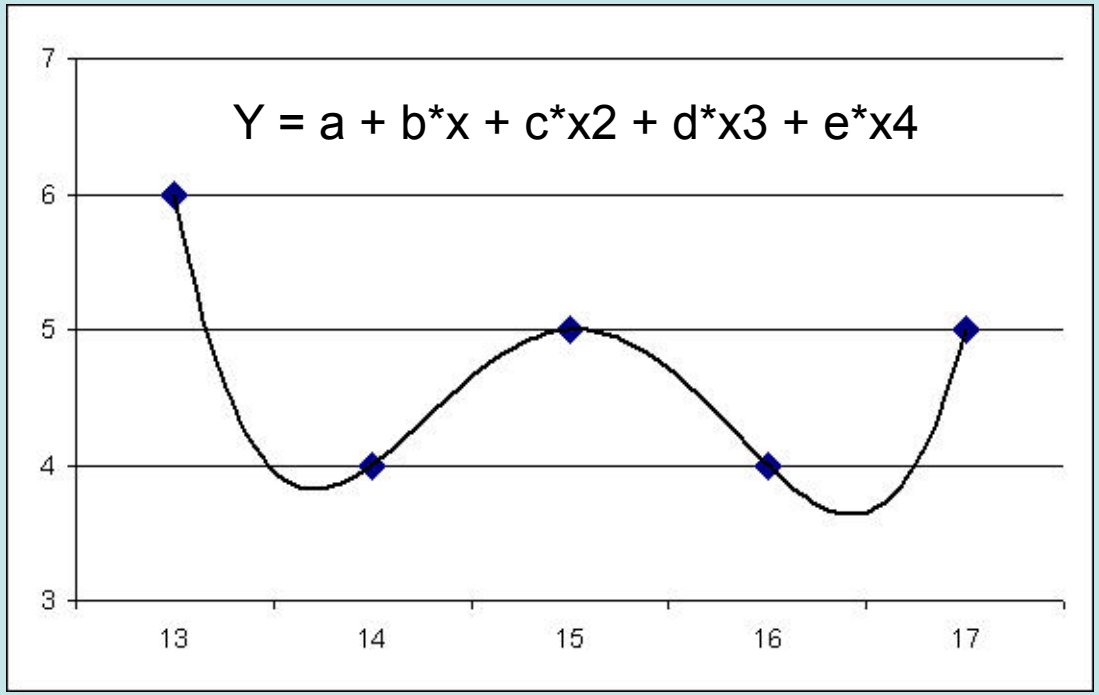
Fit the Signal

5 data points – 2 coefficients – three residual degrees of freedom



Fit the Noise – Curve-fit

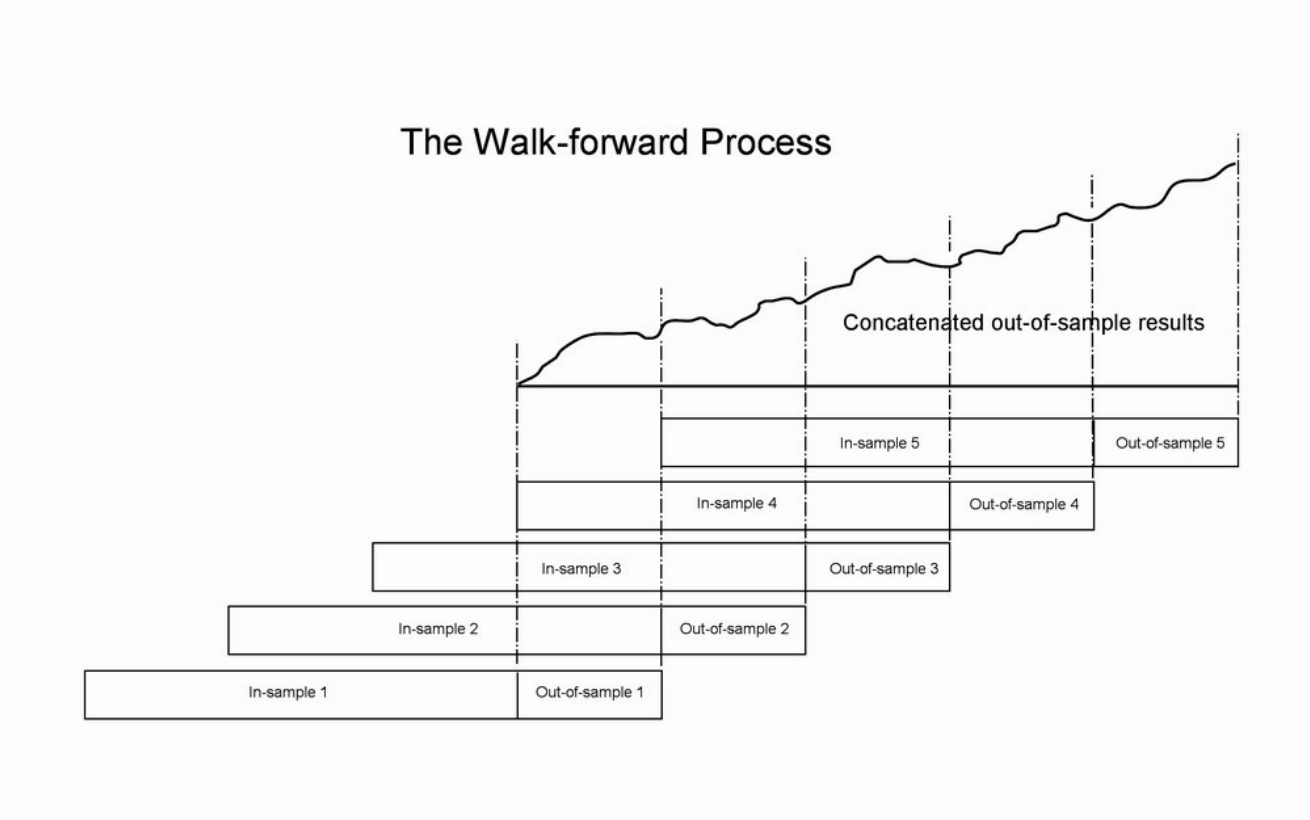
5 data points – 5 coefficients – zero residual degrees of freedom



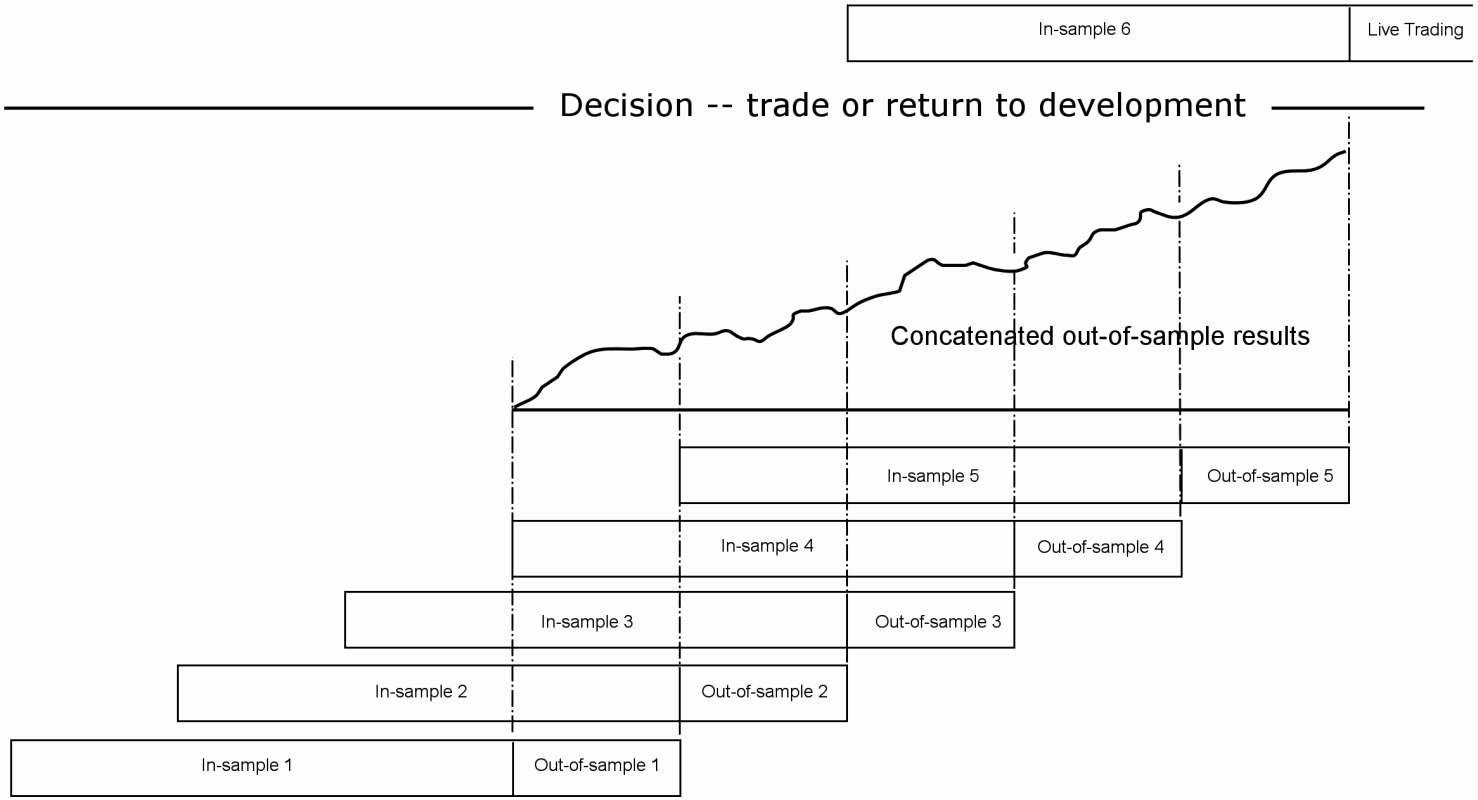
Walk Forward

- A sequence of steps, each consisting of optimizing over an in-sample period and testing over an out-of-sample period
- Automatically, advancing dates each step:
  - Optimize in-sample
  - Choose best
  - Test out-of-sample
- Accumulate out-of-sample results
- Best chosen strictly by objective function

The Walk Forward Process



Decision to Trade



Validation

- Evaluate out-of-sample results
- Decide whether to trade the system or not

- Out-of-sample results indicate how the system will react to various conditions
- In-sample results have no value in determining the likely profitability of the system

Trading

- Next Day Open (NDO)
  - Update data after close
  - Compute signals in evening
- Trade on Close of signal bar
  - Real time data feed
  - Compute price ahead
  - Anticipate signals

Monitor Results

- Compare real time results with out-of-sample test results
- All systems fail
- Use statistical tests to determine if the system is broken
- Use statistical process control techniques, if possible
- When to reoptimize

5 Wins in a Row – Now What?

- After a long string of winning trades, do you change anything?

- Probably not
  - Your system and the market are in sync
  - This is just what you hoped for, stay with it
  - Do not penalize good results

4 Losses in a Row – Now What?

- Review the trade statistics from your out-of-sample runs.
- What is the typical ratio of winning trades to losing trades?
- Is this unusual?
- Use the runs test for a statistical answer
- Or use the binomial distribution

The Binomial Distribution

- Assume your out-of-sample shows 60% winners, 40% losers
- The probability of any trade being a loser is 0.40
- The probability of two successive losers is 0.40 * 0.40 = 0.16 Expect this regularly
- Three losers in a row = 0.064 Start to worry
- Four losers in a row = 0.0256 It is broken

Practical Implementation

Everything You Need

- Everything you need is available today

- AmiBroker trading system development platform
- Any end-of-day and most real-time data sources
- Quotes Plus is a good data vendor

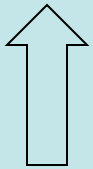
Trading System Development

1. Define the objective function
2. Decide what to trade and how to trade it
3. Design the trading system
4. Determine the in-sample period
5. Determine the out-of-sample period
6. Decide what to optimize
7. Perform walk forward runs
8. Evaluate out-of-sample results
9. Trade the system
10. Monitor the results

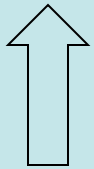
Metrics Available

Search the AmiBroker User's Guide for "getperformancestats"

10000.00	"InitialCapital"
16925.16	"EndingCapital"
6925.16	"NetProfit"
69.25	"NetProfitPercent"
16.91	"ExposurePercent"
409.52	"NetRAR"
24.00	"CAR"
141.90	"RAR"
23	"AllQty"
100.00	"AllPercent"
301.09	"AllAvgProfitLoss"
2.57	"AllAvgProfitLossPercent"
5.52	"AllAvgBarsHeld"
13	"WinnersQty"
56.52	"WinnersPercent"
10888.27	"WinnersTotalProfit"
837.56	"WinnersAvgProfit"
6.51	"WinnersAvgProfitPercent"
6.00	"WinnersAvgBarsHeld"
4	"WinnersMaxConsecutive"
3254.77	"WinnersLargestWin"
6	"WinnersLargestWinBars"



Typical value



Metric name

Metrics Available

10	"LosersQty"
43.48	"LosersPercent"
-3963.11	"LosersTotalLoss"
-396.31	"LosersAvgLoss"
-2.55	"LosersAvgLossPercent"
4.90	"LosersAvgBarsHeld" ,
2	"LosersMaxConsecutive"
-1210.84	"LosersLargestLoss"
4	"LosersLargestLossBar"

-1707.12	"MaxTradeDrawdown“
-11.66	"MaxTradeDrawdownPercent"
-2071.76	"MaxSystemDrawdown"
-13.80	"MaxSystemDrawdownPercent"
3.34	"RecoveryFactor"
1.74	"CAR/MDD"
10.28	"RAR/MDD"
2.75	"ProfitFactor"
2.11	"PayoffRatio“
883.56	"StandardError“
3.39	"RRR“
5.37	"UlcerIndex"
3.46	"UlcerPerformanceIndex"
2.31	"SharpeRatio“
0.0967	"KRatio"

Buy on Open of Next Bar

- SetTradeDelays(1,1,1,1);
- BuyPrice = Open;

- Sometimes called Next Day Open (NDO)
- Normal when using end-of-day data,
- Processing in the evening,
- Trading market on open

Buy on Close of Current Bar

- SetTradeDelays(0,0,0,0);
- BuyPrice = Close;

- Often the best entry
- Must anticipate the signal

Designing Entries

- Start with an indicator
  - Pick an entry method
  - Hold 2 days

    --- or ---
- Start with desirable result
  - Identify good entry points
  - Look for leading indicators

Lag

- Lag makes entries late
- Low lag indicators:
  - AMA
  - Zero Lag MACD
  - Regression
- Zero lag indicators:
  - Patterns
  - Statistics
  - Seasonality

Be Wary of In-sample Results

- The next few slides illustrate the in-sample and out-of-sample results of several systems
- It is impossible to tell whether results are in-sample or out-of-sample without performing the validation yourself

System 1 – In-Sample

System 1 – Out-Of-Sample

System 2 – In-Sample

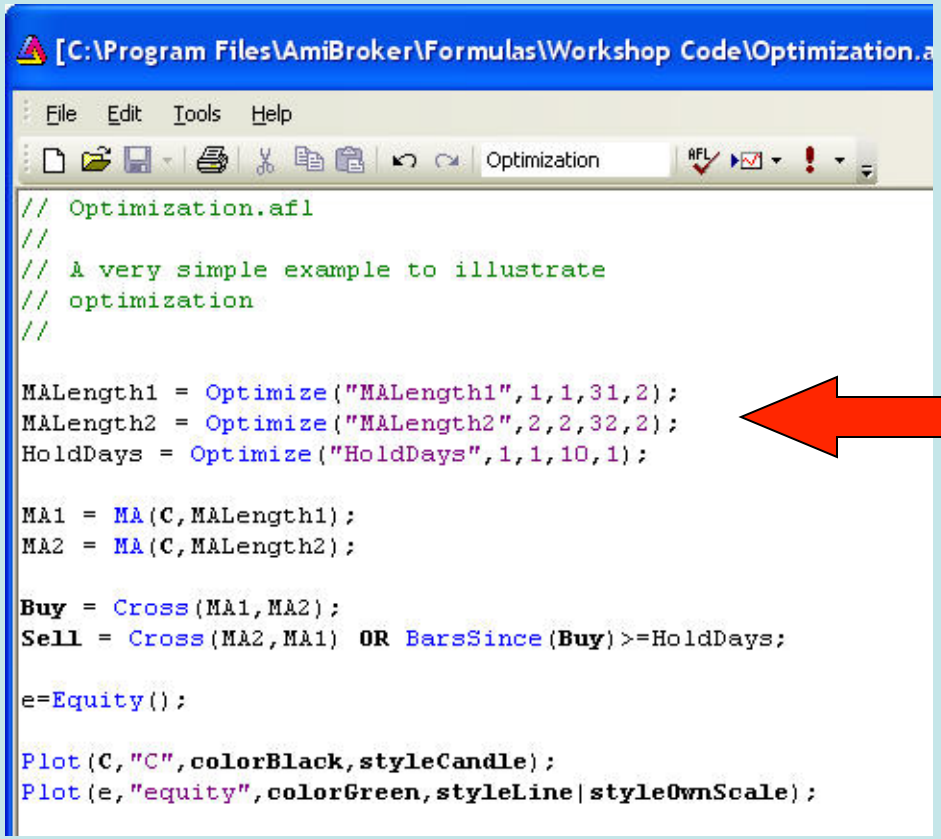
System 2 – Out-Of-Sample

System 3 – In-Sample

System 3 – Out-Of-Sample

(CMO Oscillator)

An Optimization Example



Search for the best values for these three variables

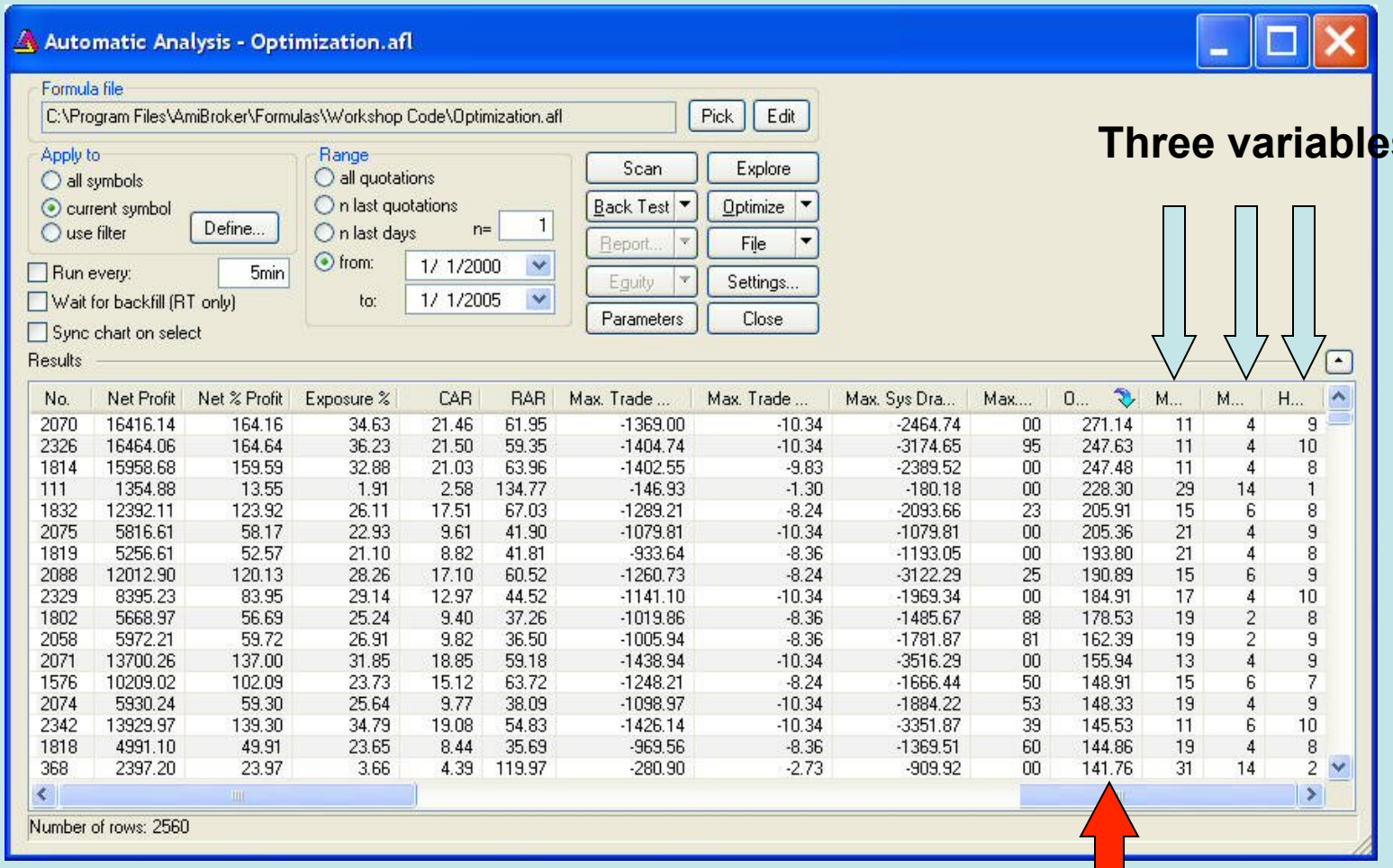
Equity Curve – Before

Backtest using default values

Optimization Settings

To begin, Click Optimize

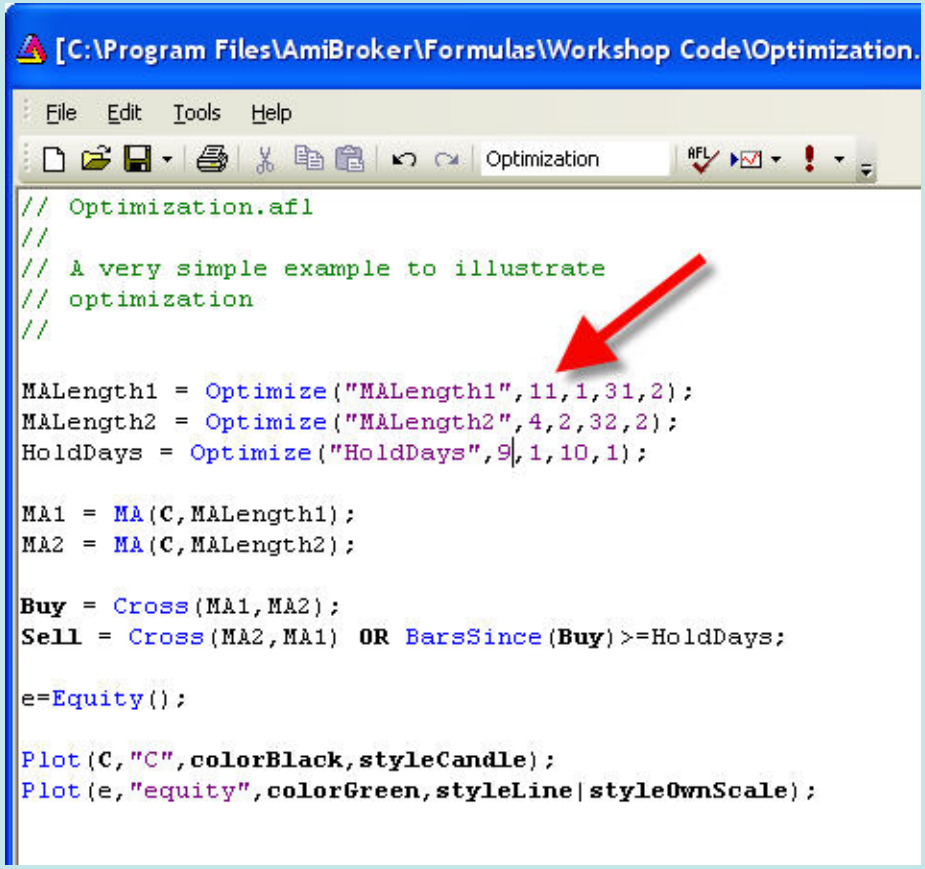
Optimization Results



No.	Net Profit	Net % Profit	Exposure %	CAR	RAR	Max. Trade ...	Max. Trade ...	Max. Sys Dra...	Max....	O...	M...	M...	H...
2070	16416.14	164.16	34.63	21.46	61.95	-1369.00	-10.34	-2464.74	00	271.14	11	4	9
2326	16464.06	164.64	36.23	21.50	59.35	-1404.74	-10.34	-3174.65	95	247.63	11	4	10
1814	15958.68	159.59	32.88	21.03	63.96	-1402.55	-9.83	-2389.52	00	247.48	11	4	8
111	1354.88	13.55	1.91	2.58	134.77	-146.93	-1.30	-180.18	00	228.30	29	14	1
1832	12392.11	123.92	26.11	17.51	67.03	-1289.21	-8.24	-2093.66	23	205.91	15	6	8
2075	5816.61	58.17	22.93	9.61	41.90	-1079.81	-10.34	-1079.81	00	205.36	21	4	9
1819	5256.61	52.57	21.10	8.82	41.81	-933.64	-8.36	-1193.05	00	193.80	21	4	8
2088	12012.90	120.13	28.26	17.10	60.52	-1260.73	-8.24	-3122.29	25	190.89	15	6	9
2329	8395.23	83.95	29.14	12.97	44.52	-1141.10	-10.34	-1969.34	00	184.91	17	4	10
1802	5668.97	56.69	25.24	9.40	37.26	-1019.86	-8.36	-1485.67	88	178.53	19	2	8
2058	5972.21	59.72	26.91	9.82	36.50	-1005.94	-8.36	-1781.87	81	162.39	19	2	9
2071	13700.26	137.00	31.85	18.85	59.18	-1438.94	-10.34	-3516.29	00	155.94	13	4	9
1576	10209.02	102.09	23.73	15.12	63.72	-1248.21	-8.24	-1666.44	50	148.91	15	6	7
2074	5930.24	59.30	25.64	9.77	38.09	-1098.97	-10.34	-1884.22	53	148.33	19	4	9
2342	13929.97	139.30	34.79	19.08	54.83	-1426.14	-10.34	-3351.87	39	145.53	11	6	10
1818	4991.10	49.91	23.65	8.44	35.69	-969.56	-8.36	-1369.51	60	144.86	19	4	8
368	2397.20	23.97	3.66	4.39	119.97	-280.90	-2.73	-909.92	00	141.76	31	14	2

Sorted by Objective Function

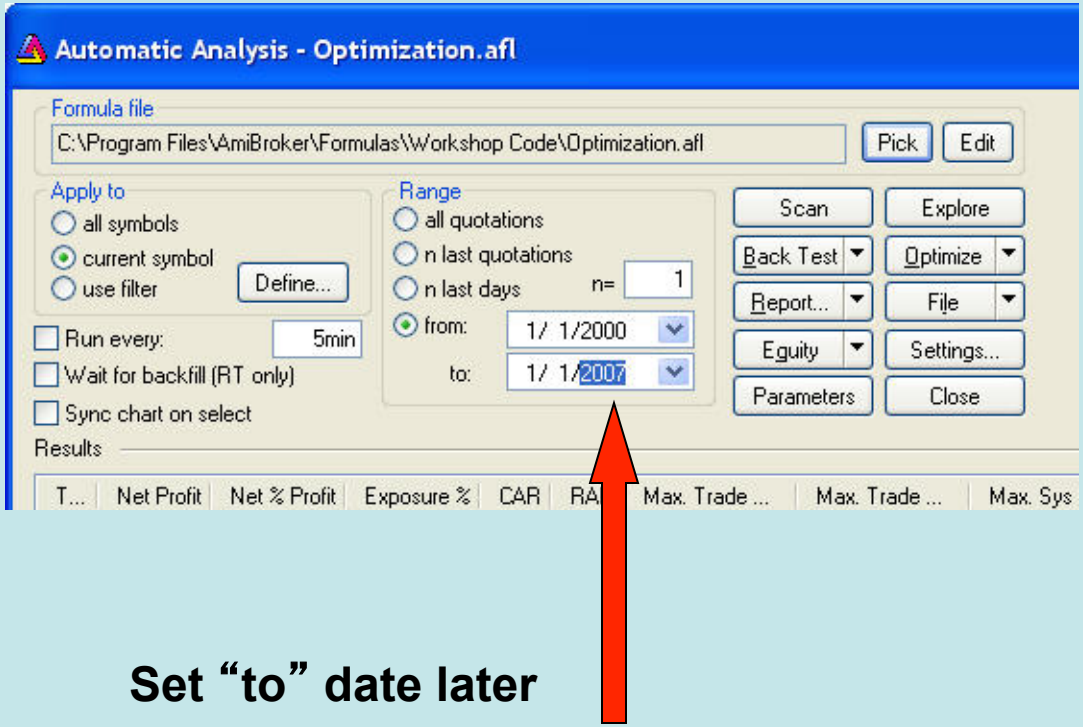
Optimal Values Entered



Equity Curve – After

This is In-Sample, and it looks good

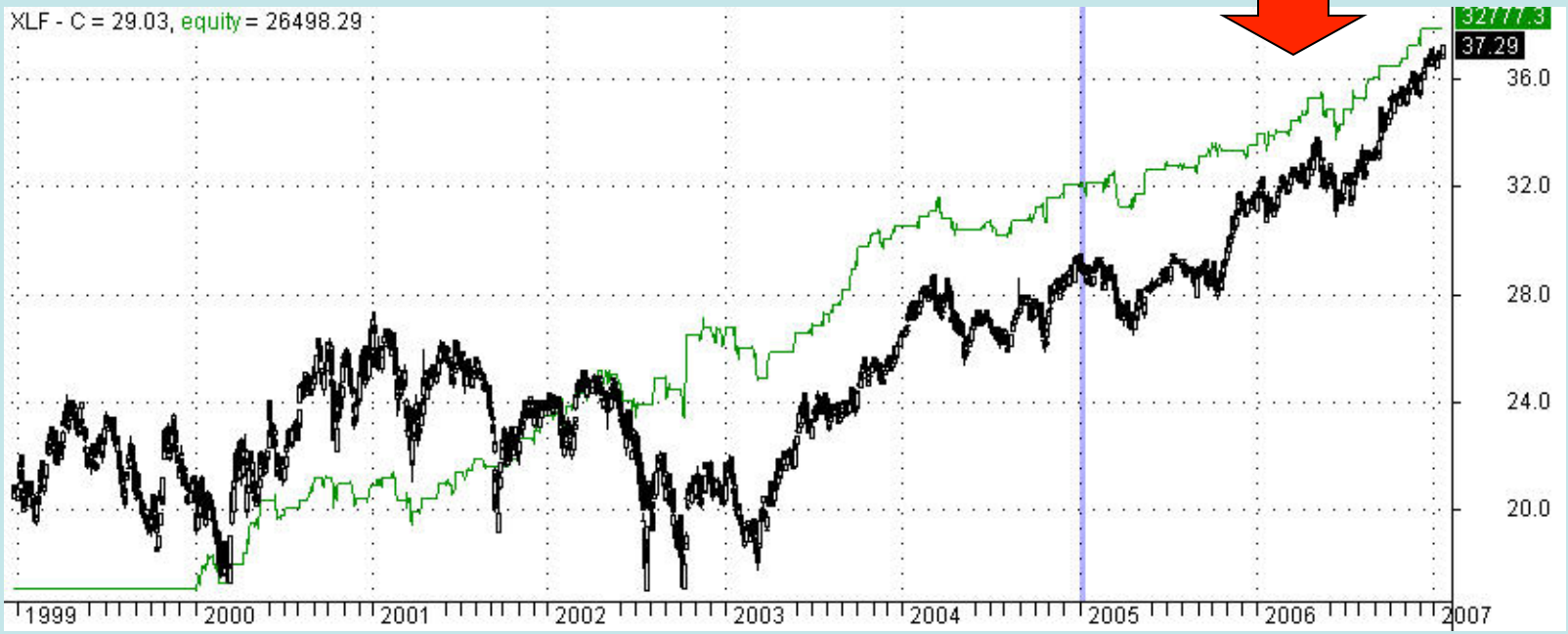
Settings to Test OOS



Set "to" date later

Equity Curve – Out-Of-Sample

2005 and 2006 are Out-Of-Sample, and look good

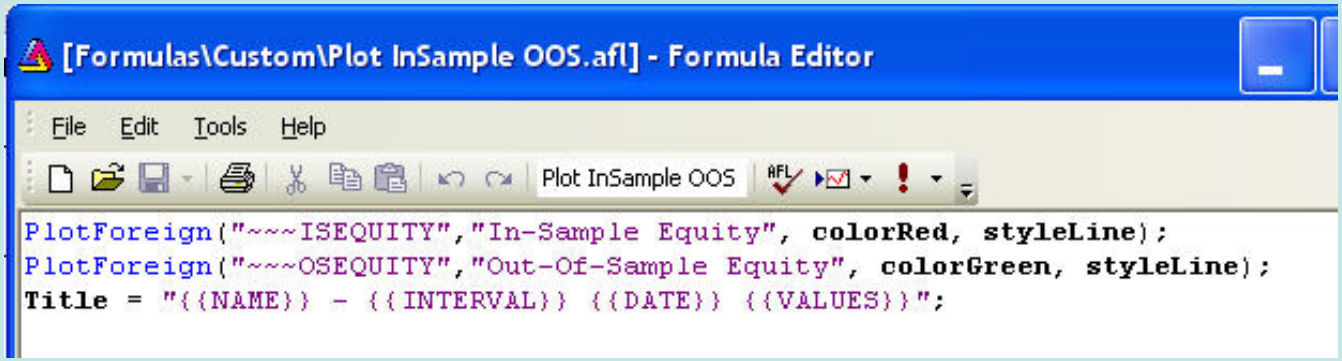


Walk Forward Example

- AmiBroker has native walk forward testing from Version 5.05

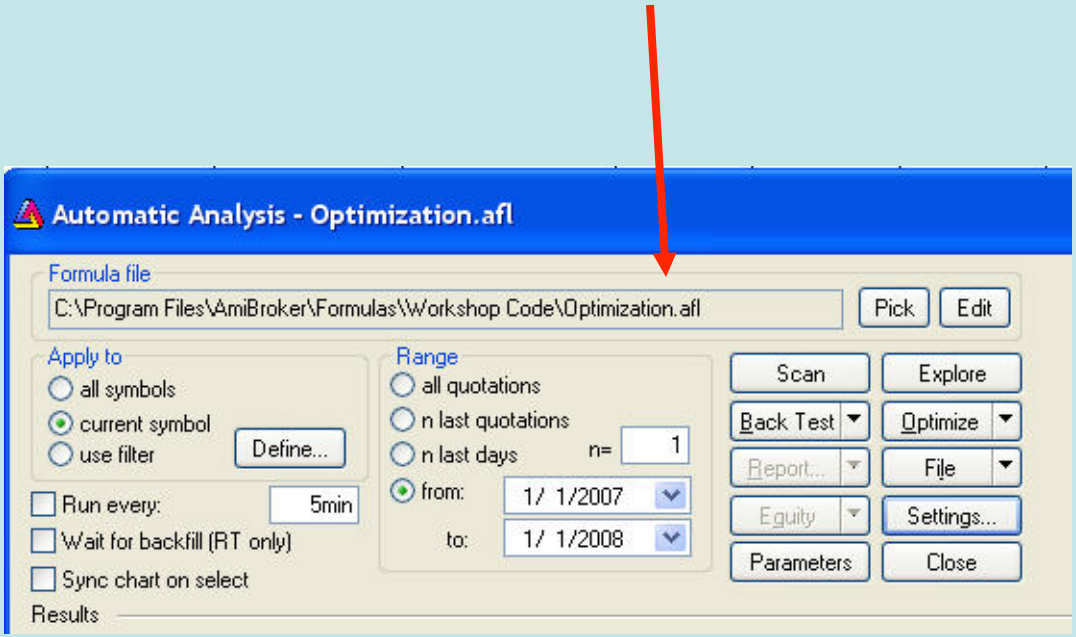
Install Plot InSample OOS.afl

Copy to AmiBroker\Formulas\Custom

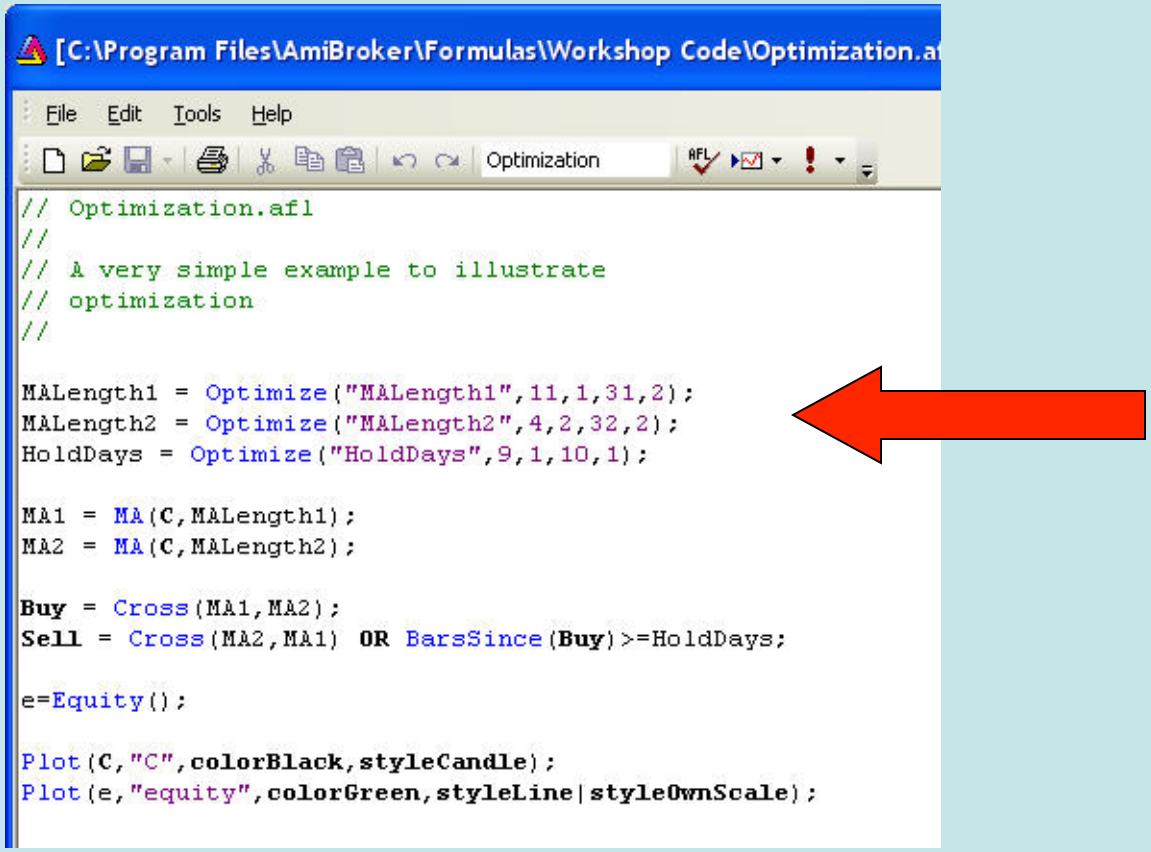


Select the System to Test

Automatic Analysis > Pick – as usual



Note Optimization Statements



Settings

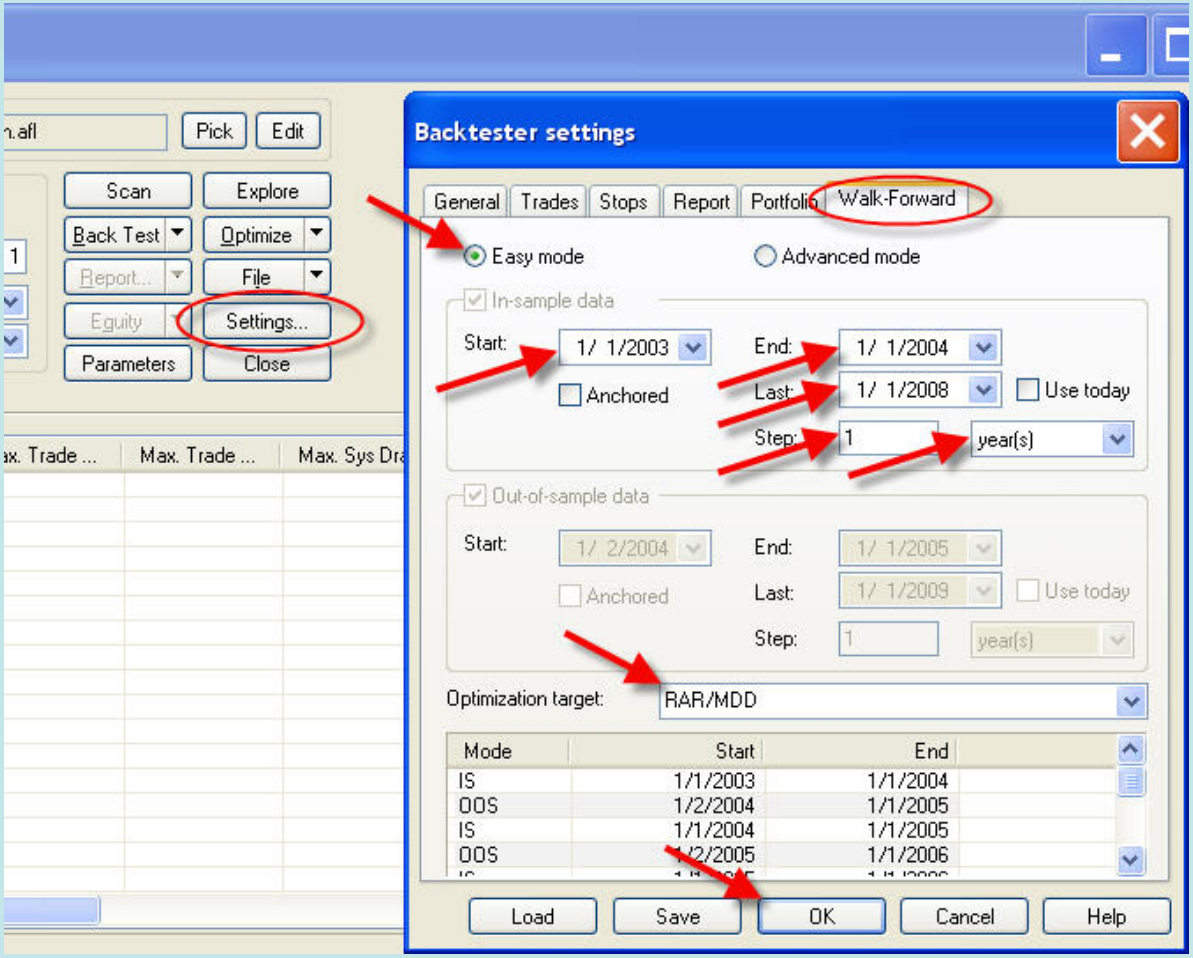
Settings

Walk Forward

Set Dates

Select Objective

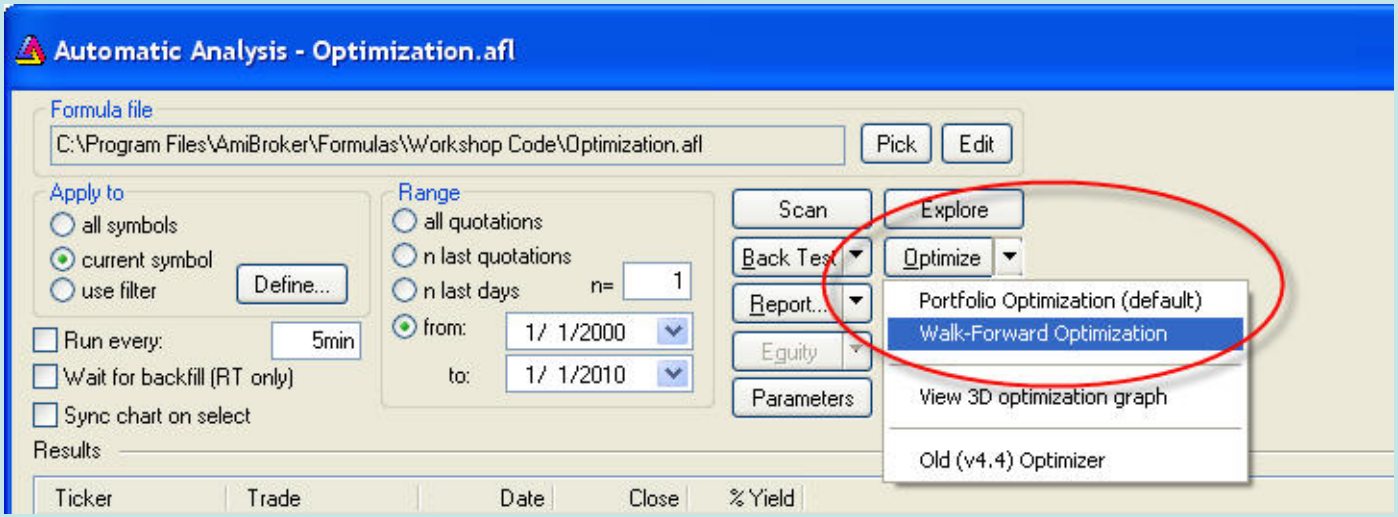
OK



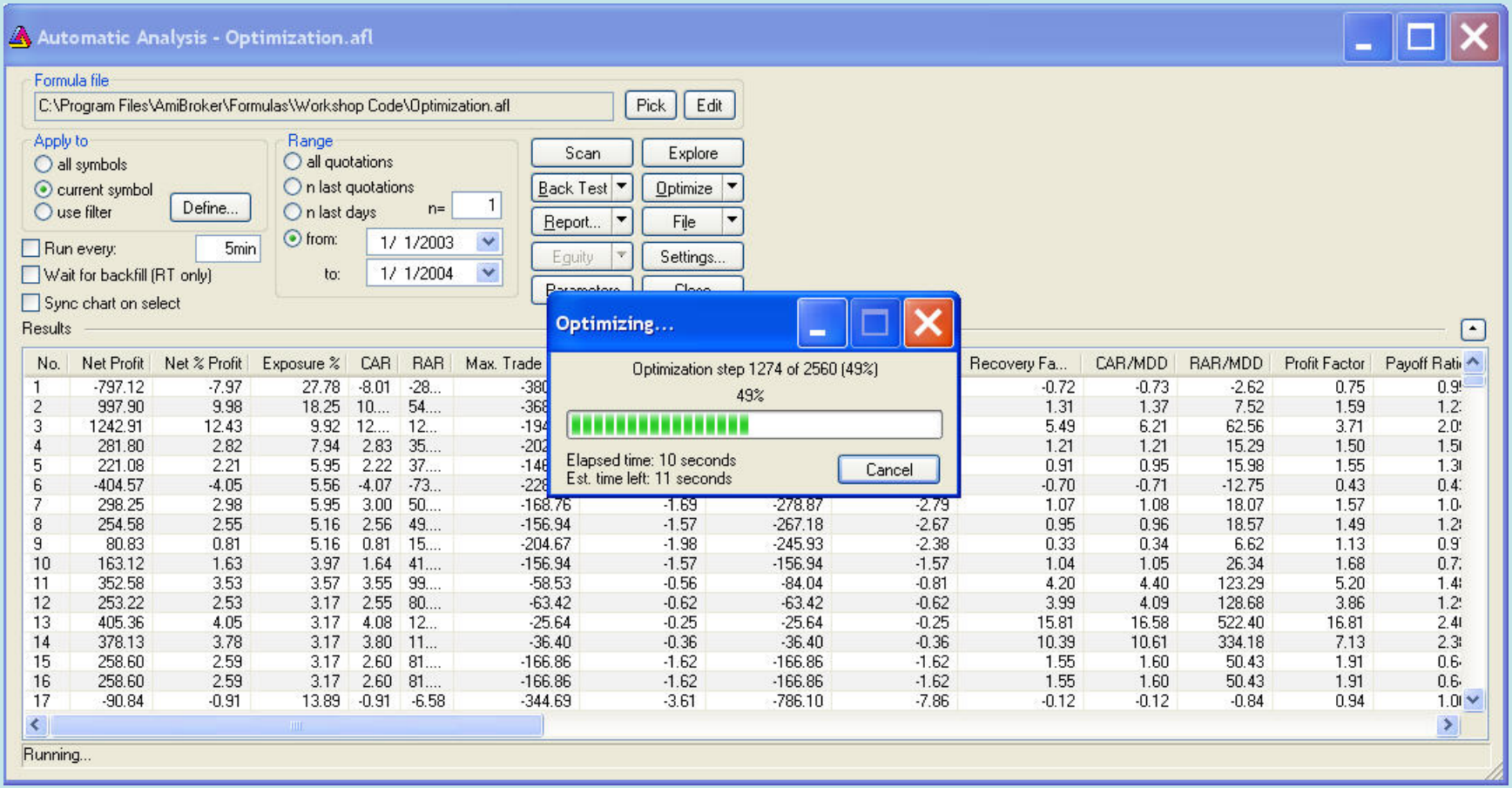
Start Walk Forward Run

Optimize

Walk Forward

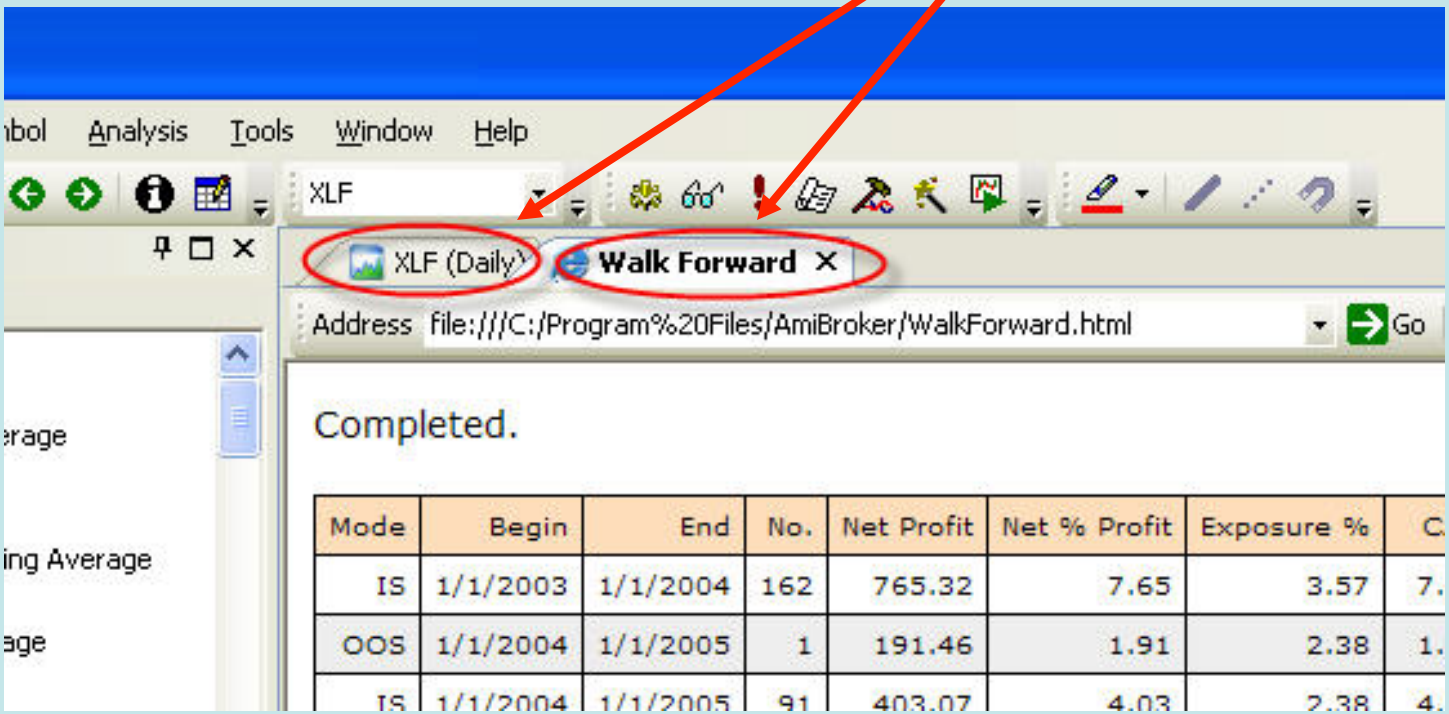


Results Window



Two Tabs

Minimize "Optimizing" window to reveal these

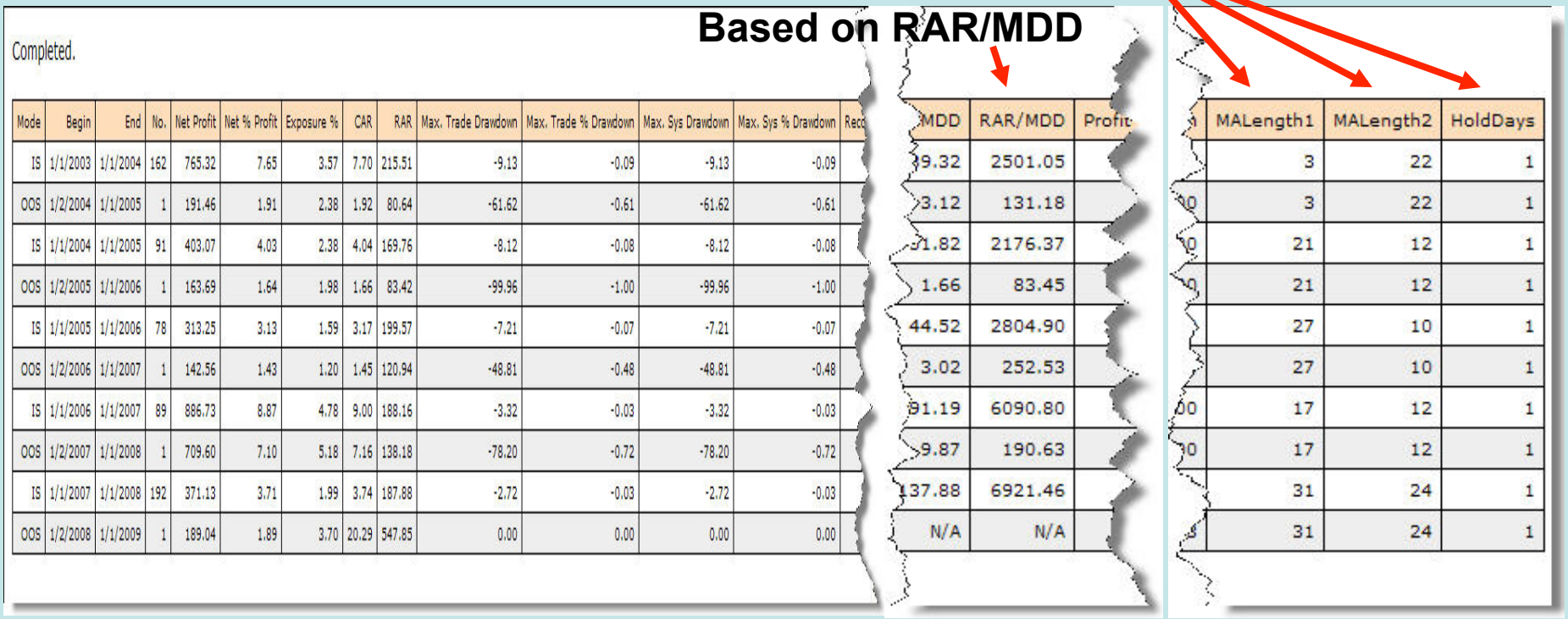


Walk Forward Tab

Displays in-sample and out-of-sample results for each step

Best values for parms

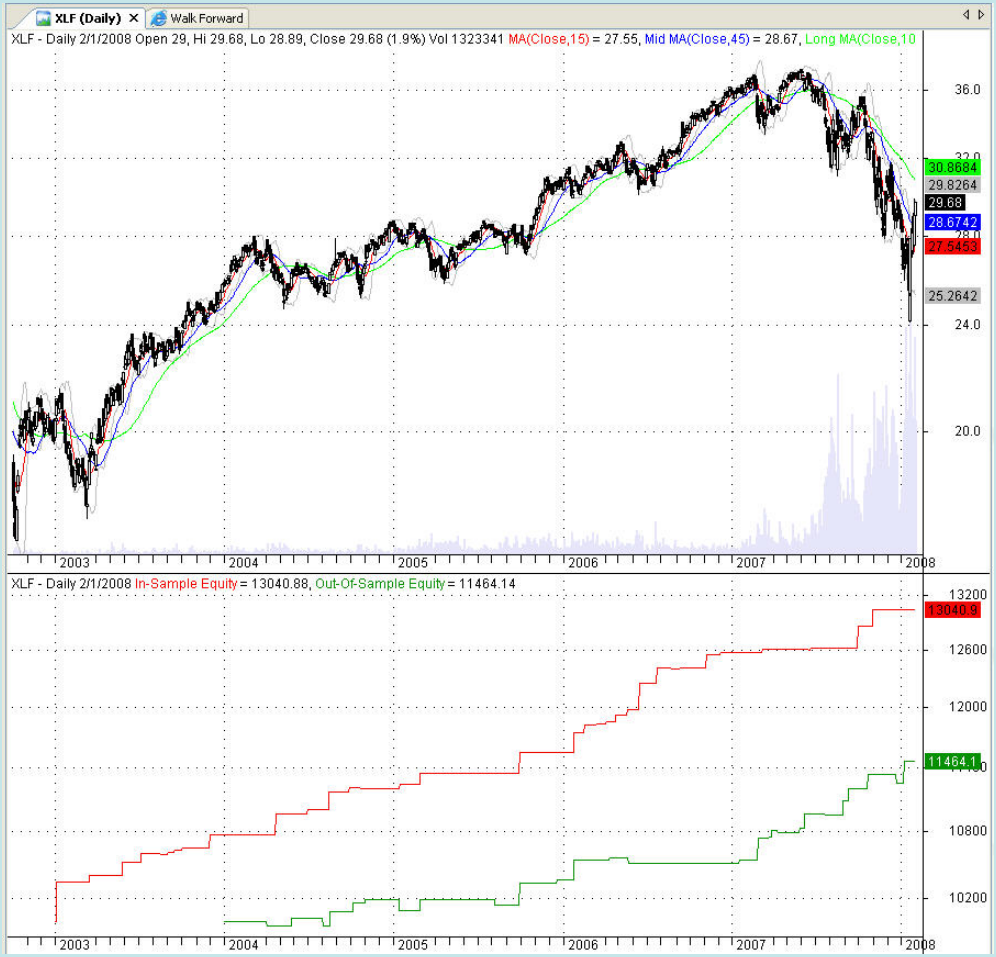
Based on RAR/MDD



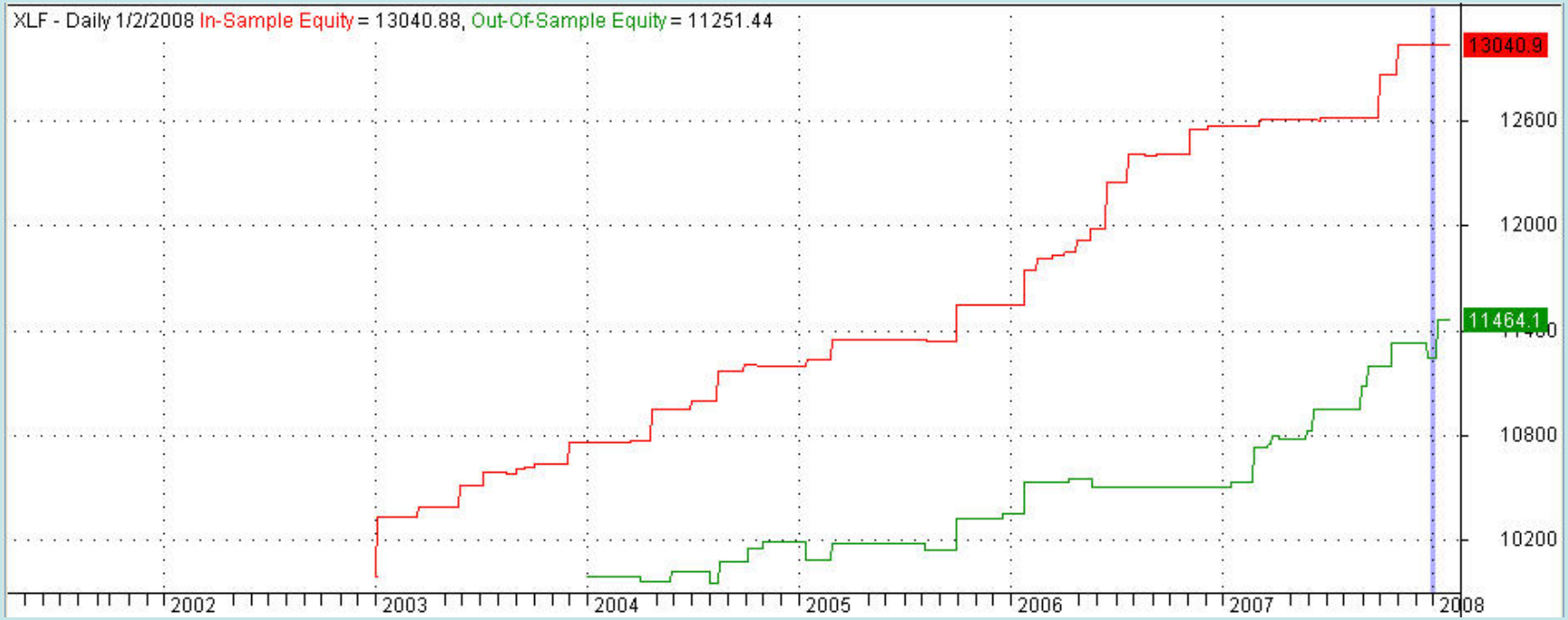
Completed.

Mode	Begin	End	No.	Net Profit	Net % Profit	Exposure %	CAR	RAR	Max. Trade Drawdown	Max. Trade % Drawdown	Max. Sys Drawdown	Max. Sys % Drawdown	Reco	MDD	RAR/MDD	Profit	MALength1	MALength2	HoldDays
IS	1/1/2003	1/1/2004	162	765.32	7.65	3.57	7.70	215.51	-9.13	-0.09	-9.13	-0.09		9.32	2501.05		3	22	1
OOS	1/2/2004	1/1/2005	1	191.46	1.91	2.38	1.92	80.64	-61.62	-0.61	-61.62	-0.61		3.12	131.18		3	22	1
IS	1/1/2004	1/1/2005	91	403.07	4.03	2.38	4.04	169.76	-8.12	-0.08	-8.12	-0.08		1.82	2176.37		21	12	1
OOS	1/2/2005	1/1/2006	1	163.69	1.64	1.98	1.66	83.42	-99.96	-1.00	-99.96	-1.00		1.66	83.45		21	12	1
IS	1/1/2005	1/1/2006	78	313.25	3.13	1.59	3.17	199.57	-7.21	-0.07	-7.21	-0.07		44.52	2804.90		27	10	1
OOS	1/2/2006	1/1/2007	1	142.56	1.43	1.20	1.45	120.94	-48.81	-0.48	-48.81	-0.48		3.02	252.53		27	10	1
IS	1/1/2006	1/1/2007	89	886.73	8.87	4.78	9.00	188.16	-3.32	-0.03	-3.32	-0.03		91.19	6090.80		17	12	1
OOS	1/2/2007	1/1/2008	1	709.60	7.10	5.18	7.16	138.18	-78.20	-0.72	-78.20	-0.72		9.87	190.63		17	12	1
IS	1/1/2007	1/1/2008	192	371.13	3.71	1.99	3.74	187.88	-2.72	-0.03	-2.72	-0.03		137.88	6921.46		31	24	1
OOS	1/2/2008	1/1/2009	1	189.04	1.89	3.70	20.29	547.85	0.00	0.00	0.00	0.00		N/A	N/A		31	24	1

Chart Tab


XLF (Daily)
Walk Forward
XLF - Daily 2/1/2008 Open 29, Hi 29.68, Lo 28.89, Close 29.68 (1.9%) Vol 1323341 MA(Close,15) = 27.55, Mid MA(Close,45) = 28.67, Long MA(Close,10
36.0
30.8684
29.8264
29.68
28.6742
27.5453
25.2642
24.0
20.0
2003
2004
2005
2006
2007
2008
XLF - Daily 2/1/2008 In-Sample Equity = 13040.88, Out-Of-Sample Equity = 11464.14
13200
13040.9
12600
12000
11464.1
10800
10200
2003
2004
2005
2006
2007
2008

I.S. and O.O.S. Equity Curves



Just for NAAIM

A system using weekly data

ETF Selection Example

- Nine S&P Sector ETFs
- Weekly data – Hold 1 to 3 sectors
- Compute signals after Friday's close
- Trade Monday's open
- Two methods in one system
  - Trend following
  - Mean reversion
- 6 mo in-sample, 6 mo out-of-sample

ETF Selection – Code

```
// NAAIM.afl
//
SetTradeDelays(1,1,1,1);
BuyPrice = Open;
SellPrice = Open;
TimeFrameSet(inWeekly);

NumberPositions = Optimize("NumPos",2,1,3,1);
SetOption("MaxOpenPositions", NumberPositions);

PositionSize = -100 / NumberPositions;

Trend = Optimize("Trend",1,1,2,1);
ROCLen = Optimize("ROCLen",5,2,20,2);
MALen = Optimize("MALen",5,2,20,2);

if (Trend == 1)
{
// Buy Strength
Strength = ROC(C,ROCLen);
Buy = Strength > 0;
Sell = Strength < 0;
PositionScore = Strength;
}
else
{
// Buy Weakness
Z = (C - MA(C,MALen)) / StDev(C,MALen);
Buy = Z < 0 AND Z > Ref(Z,-1);
Sell = Z < Ref(Z,-1);
PositionScore = -Z;
}
```

Optimize:

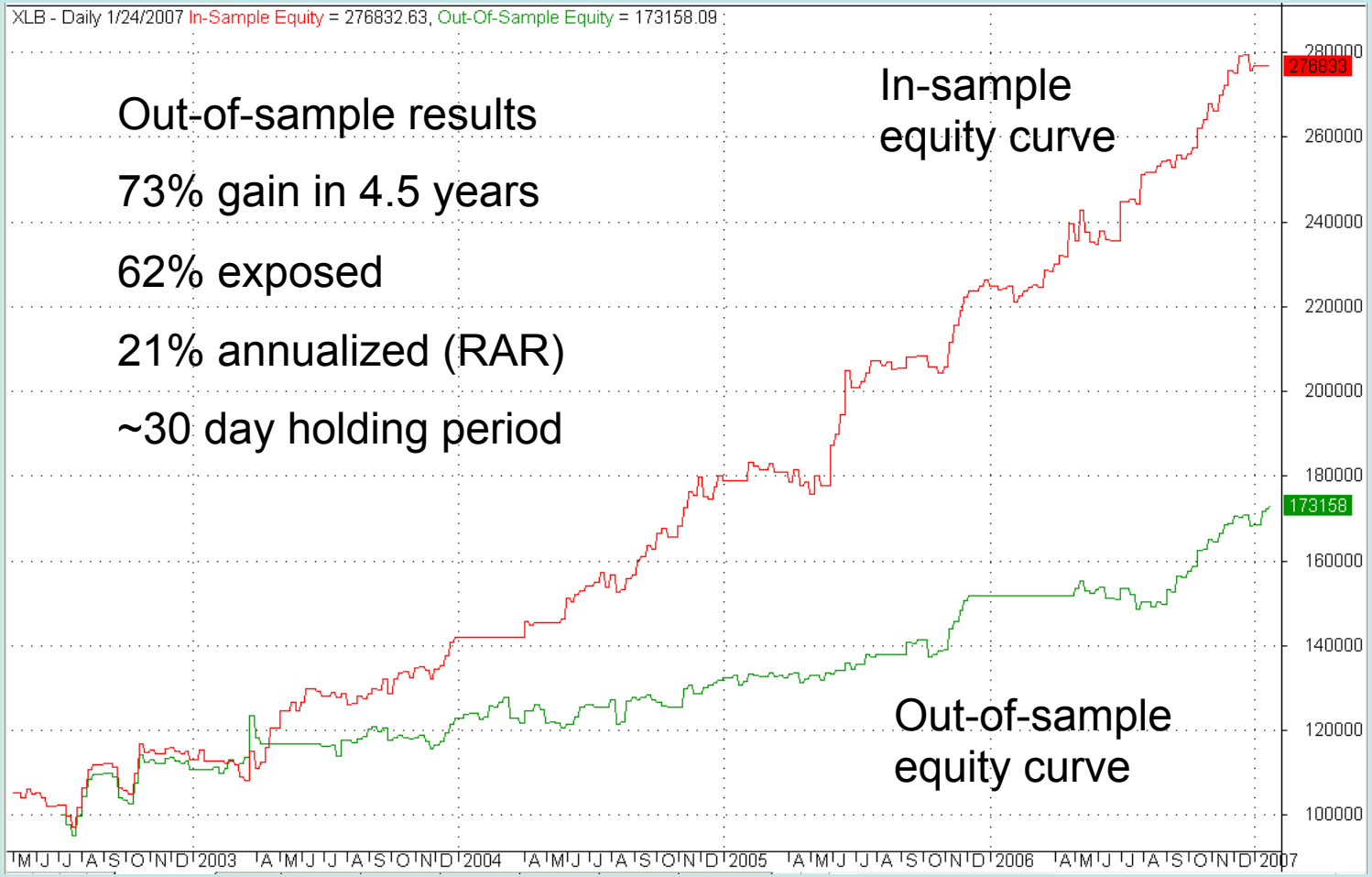
Number to hold

Three Variables

ETF Selection – Walk forward

Mode	Begin	End	No.	Net Profit	Net % Profit	Exposure %	CAR	RAR	Avg Bars Held	Max. Sys % Drawdown	NumPos	Trend	ROCLen	MALen
IS	1/1/2002	7/1/2002	6	2367.01	2.37	44.98	5.00	11.12	3.06	-5.93	3	2	2	2
OOS	7/2/2002	1/1/2003	1	10821.82	10.82	48.73	23.90	49.04	3.00	-6.53	3	2	2	2
IS	7/1/2002	1/1/2003	6	10821.82	10.82	48.73	23.90	49.04	3.00	-6.53	3	2	2	2
OOS	1/2/2003	7/1/2003	1	4851.15	4.85	26.93	10.38	38.57	3.10	-5.86	3	2	2	2
IS	1/1/2003	7/1/2003	2	16681.16	16.68	71.09	37.96	53.39	4.70	-6.16	2	1	2	2
OOS	7/2/2003	1/1/2004	1	6444.22	6.44	76.95	13.83	17.97	3.86	-4.27	2	1	2	2
IS	7/1/2003	1/1/2004	39	11064.88	11.06	94.01	24.31	25.86	13.17	-2.59	3	1	14	2
OOS	1/2/2004	7/1/2004	1	2665.25	2.67	88.01	5.64	6.41	8.56	-5.66	3	1	14	2
IS	1/1/2004	7/1/2004	485	8581.20	8.58	28.83	18.73	64.98	4.00	-0.61	2	2	2	18
OOS	7/2/2004	1/1/2005	1	4198.28	4.20	50.17	8.60	17.14	3.70	-4.65	2	2	2	18
IS	7/1/2004	1/1/2005	33	15429.74	15.43	99.92	33.35	33.37	21.25	-3.05	3	1	12	2
OOS	1/2/2005	7/1/2005	1	-777.75	-0.78	71.85	-1.62	-2.25	7.88	-4.44	3	1	12	2
IS	1/1/2005	7/1/2005	304	13142.36	13.14	57.69	29.37	50.91	3.50	-4.03	1	2	2	12
OOS	7/2/2005	1/1/2006	1	12850.02	12.85	50.00	28.68	57.36	4.25	-2.78	1	2	2	12
IS	7/1/2005	1/1/2006	546	11908.28	11.91	53.24	25.31	47.54	4.91	-1.94	3	2	2	20
OOS	1/2/2006	7/1/2006	1	1139.97	1.14	21.85	2.39	10.95	3.13	-2.78	3	2	2	20
IS	1/1/2006	7/1/2006	3	11272.28	11.27	78.36	24.95	31.84	4.59	-3.33	3	1	2	2
OOS	7/2/2006	1/1/2007	1	9266.10	9.27	87.25	20.30	23.27	6.67	-3.65	3	1	2	2
IS	7/1/2006	1/1/2007	9	13186.06	13.19	93.57	29.48	31.50	13.17	-1.36	3	1	4	2
OOS	1/2/2007	7/1/2007	1	2074.87	2.07	100.00	48.37	48.37	5.00	-0.61	3	1	4	2

EFT Selection – Equity Curves



How to Build an Effective Trading System

(and Build Confidence that It Will Be Profitable)

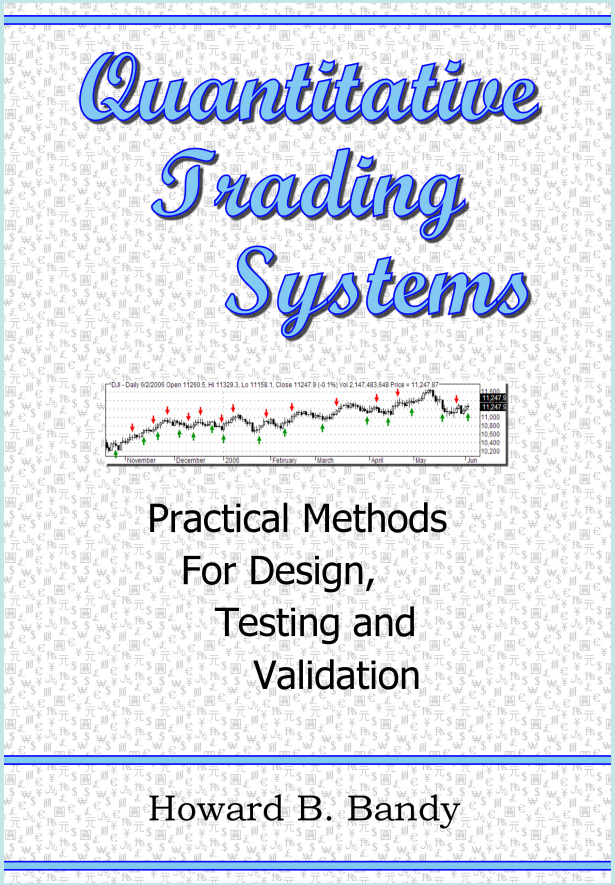
Trading System Development

1. Define the objective function
2. Decide what to trade and how to trade it
3. Design the trading system
4. Determine the in-sample period
5. Determine the out-of-sample period
6. Decide what to optimize
7. Perform walk forward runs
8. Evaluate out-of-sample results
9. Trade the system
10. Monitor the results

Questions and Comments

Quantitative Trading Systems

- Expands on topics presented today
- Subtitled “Practical Methods for Design, Testing, and Validation”
- Published in 2007
- Very well received
- Shipped to over 35 countries



Contact Information

- To discuss or schedule a seminar, workshop, custom programming, or consulting:

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- (520) 705-1239 (cell)
- howard@BlueOwlPress.com

Resources

- AmiBroker www.amibroker.com
- Quotes Plus www.quotes-plus.com
- Quantitative Trading Systems
  www.quantitativetradingsystems.com

- www.quantitativetradingsystems.com/resources

The End