

# **Straightforward Method to Mechanically Refine Your Trading Strategies Using Amibroker**

ATAS Meeting March 2, 2016

Mark Bates, CFTe

# Outline

- Step By Step Method to Install Amibroker
- Step By Step Method to Write Your Strategy
- Step By Step Method to Backtest Your Strategy
- Step By Step Method to Forward Test Your Strategy

# Testing Considerations

- *Back testing* refers to applying a trading system to historical data to verify how a system would have performed during the specified time period.
- *Forward testing* is also known as *Walk forward testing* is the simulation of the real markets data on paper only
- *Walk forward optimization* is a method used in finance for determining the best parameters to use in a trading strategy. The trading strategy is optimized with in sample data for a time window in a data series. The remainder of the data are reserved for out of sample testing.
- Today I will demonstrate Back Testing and Walk Forward Optimization using Amibroker.

# Amibroker Home Page



Navigate to Amibroker home page at URL [www.amibroker.com](http://www.amibroker.com)

## AmiBroker

for Windows 10, 8, 7, Vista, XP, 2000, 9x

welcome features news download order support faq wish list links

The ultimate choice for portfolio-level system design, testing and validation

Search  
keyword  go

### New! AmiBroker 6.10

Featuring integrated Visual Debugger, Matrix arithmetic, hyper fast Monte Carlo simulator, new Formula Editor with Code Snippets, layered Low-level Graphics, massively parallel Multi-Threaded Charting and Rendering, new Multi-Threaded Analysis module, automatic Walk-Forward Testing, new Ranking functions, Multi-monitor floating charts, symbol and interval linking, drag-and-drop indicator creation, Industry fastest, multi-threaded unlimited-symbol True Portfolio-Level Backtesting and Optimization, now with Smart Evolutionary algorithms, scaling market-neutral system support and multiple currency handling. One-click setup and update of US stocks listing with sector and industry assignments, free Fundamental data, Multiple Time-Frame support, 3D optimization charts, new Account manager, automated trading interface, volume profile, object-oriented charting, drawing layers, multi-window layouts, formula-based alerts, easy-to-use formula editor, equity function, unique composite indicators, built-in web research browser, direct link to eSignal, Interactive Brokers, IQFeed, myTrack, FastTrack, QP2, TC2000, any DDE compliant feed, MS and more... [Download FREE TRIAL](#)

**Standard \$279**  
**Professional \$339**  
one-time fee  
**BUY NOW!**  
**LEARN MORE**

[click to enlarge](#)

Reasons why we are better than competition:

- **FEATURE RICH** - the most complete set of features available plus we add new features every day on user request.
- **RELIABILITY and ACCURACY** - thoroughly tested and used every day by community of thousands of traders, fund managers, etc. Our backtester can reproduce virtually any trade strategy with real life...

AmiBroker works with:

- eSignal (REAL TIME quotes)
- IQFEED (REAL TIME quotes)
- Interactive Brokers (REAL TIME quotes)
- Premium Data Norgate Investor Services (EOD quotes)
- CSF EOD-OF-DAY DATA SERVICE CSI
- myTrack (REAL TIME quotes)
- TC2000.com (EOD quotes)
- INVESTORS' FastTrack (EOD quotes)

[Click here for complete list of supported data sources](#)

BOOKS:



# Download Tab



## AmiBroker

for Windows 10, 8, 7, Vista, XP, 2000, 9x

welcome features news **download** order support faq wish list links

Advanced stock charting and analysis program

### AmiBroker 6.10 official release

Brand new AmiBroker 6.10 official release is available for registered customers only from member's area. [See DevLog for the details.](#)

### AmiBroker 6.00 official release (old version) - recommended for most users

Stock charting and analysis program, free trial version (after you purchase the license it will be unlocked). Works on BOTH 64-bit and 32-bit Windows (all x86/x64 versions). Universal installer for BOTH Professional and Standard versions. Recommended for most users.

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 32 bit</a>	6.00.2 (6.00.2.6002)	Oct 8, 2015	9MB (9,412,094)	Windows 10, Windows 8, Windows 7, Windows Vista, Windows XP, Windows 2000, Windows Me, Windows NT, Windows 9x	<b>NEW</b> AmiBroker 6.00 official release Standard & Professional Editions. Full setup with program, help and example files. Self-Extracting EXE.  <b>This universal installer supports:</b> <ul style="list-style-type: none"><li>full installation (both registered and trial)</li><li>upgrade installation</li></ul>

This setup file is digitally signed with [Microsoft authenticode](#) to ensure its integrity and authenticity.

**UPGRADE NOTICE:** Version 6.00 is a free upgrade only for users who registered after May 31, 2013. For more details [click here](#). Note that 32-bit and 64-bit versions are SEPARATE. They are installed in different folders and require different registration key. If in doubt, use 32-bit version, as it works everywhere.

### AmiBroker 6.00 official release 64-bit

Stock charting and analysis program, 64-bit version. Works on only on 64-bit Windows. Professional-only version. Standard license does NOT work with 64-bits.

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker</a>	6.00.2	Oct 8, 2015	10MB (10,085,800)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista	<b>NEW</b> AmiBroker 6.00 official release Professional Edition. Full setup with program, help and example files. Self-Extracting EXE.  <b>This universal installer</b>

Amibroker loads with all utilities using a single link.

Pick the 32 bit option if you are unsure between the 32 and 64 bit options.

# Post Download

AmiBroker - Downlo: x  
www.amibroker.com/download.html

Advanced stock charting and analysis program

► **AmiBroker 6.10 official release**

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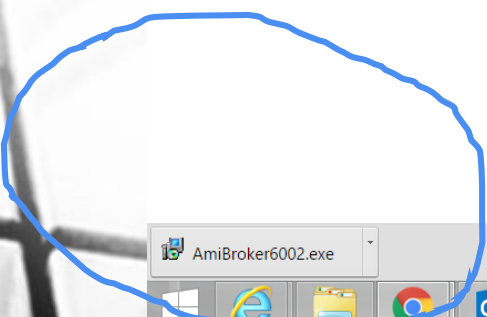
File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 64 bit</a>	6.00.2 (6.00.2.0002)	Oct 8, 2015	10MB (10,085,000)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista x64	<b>NEW</b> AmiBroker 6.00 official release Professional Edition, Full setup with program, help and example files. Self-Extracting EXE.  <b>This universal installer supports:</b> <ul style="list-style-type: none"><li>full installation</li></ul>

AmiBroker6002.exe

Show all downloads...

12:07 PM 2/23/2016

The download takes very little time.



# Wizard Starts

AmiBroker - Download x  
www.amibroker.com/download.html

Advanced stock charting and analysis program

► **AmiBroker 6.10 official release**

Brand new AmiBroker 6.10 official release is available for registered customers only from member's area. See [DevLog for the details](#).

► **AmiBroker 6.00 official release (old version)**  
- recommended for most users

Stock charting and analysis program, free trial version (after you purchase the license it will be unlocked).

Works Prof 15

Setup - AmiBroker

Welcome to the AmiBroker Setup Wizard

This will install AmiBroker 6.00 on your computer.  
It is recommended that you close all other applications before continuing.  
Click Next to continue, or Cancel to exit Setup.

Next > Cancel

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 64 bit</a>	6.00.2 (6.00.2.6002)	Oct 8, 2015	10MB (10,065,000)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista x64	<b>NEW</b> AmiBroker 6.00 official release Professional Edition, <b>Full setup</b> with program, help and example files. <b>Self-Extracting EXE.</b> <b>This universal installer supports:</b> <ul style="list-style-type: none"><li>full installation (both registered and trial)</li><li>upgrade installation</li></ul>

Double-click on the download file to start the install.

# Install to D Drive

I run Amibroker from a thumb drive that I can insert into any machine.

But you can install to your C drive and that is likely the most common option.

The screenshot shows a web browser window displaying the Amibroker download page. The page title is "AmiBroker - Download" and the URL is "www.amibroker.com/download.html". The page content includes a header "Advanced stock charting and analysis program" and two main sections: "AmiBroker 6.10 official release" and "AmiBroker 6.00 official release (old version) - recommended for most users". A blue circle highlights the "AmiBroker 6.00 official release" section. Below the text, a "Browse For Folder" dialog box is open, showing a list of folders. The "Removable Disk (D:)" folder is selected, and a sub-folder named "AmiBroker" is highlighted. Below the dialog box, a table lists the available software versions.

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 64 bit</a>	6.00.2 (6.00.2.6002)	Oct 8, 2015	10MB (10,085,600)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista x64	<b>NEW</b> AmiBroker 6.00 official release Professional Edition, Full setup with program, help and example files. Self-Extracting EXE.  This universal installer supports: <ul style="list-style-type: none"><li>• full installation (both registered and trial)</li><li>• upgrade installation</li></ul>



# Full Installation

You want the “Full” installation since it is brand new. Thereafter, updates are “Upgrade” installs.

AmiBroker - Download: x  
www.amibroker.com/download.html

Advanced stock charting and analysis program

► **AmiBroker 6.10 official release**

Brand new AmiBroker 6.10 official release is available for registered customers only from member's area. [See DevLog for the details.](#)

► **AmiBroker 6.00 official release (old version)**  
- recommended for most users

Stock charting and analysis program, free trial version (after you purchase the license it will be unlocked).

Works  
Profe

Setup - AmiBroker

Choose setup type  
Please select setup type

"Full installation" should be selected for first-time installations and in case when you want to recreate original setup condition.

"Upgrade installation" should be used when you have earlier version already installed.

Full Installation

< Back Next > Cancel

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 64 bit</a>	6.00.2 (6.00.2.0002)	Oct 8, 2015	10MB (10,095,000)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista x64	<b>NEW!</b> AmiBroker 6.00 official release Professional Edition, Full setup with program, help and example files. Self-Extracting EXE. <b>This universal installer supports:</b> <ul style="list-style-type: none"><li>• full installation (both registered and trial)</li><li>• upgrade installation</li></ul>

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12:09 PM  
2/23/2016

# Install Complete – Launch Amibroker

It finishes loading quickly. Then launch it.

AmiBroker - Download x  
www.amibroker.com/download.html

Advanced stock charting and analysis program

► **AmiBroker 6.10 official release**

Brand new AmiBroker 6.10 official release is available for registered customers only from member's area. [See DevLog for the details.](#)

► **AmiBroker 6.00 official release (old version)**  
- recommended for most users

Stock charting and analysis program, free trial version (after you purchase the license it will be unlocked).

Works  
Profes 15

Setup - AmiBroker

**Completing the AmiBroker Setup Wizard**

Setup has finished installing AmiBroker on your computer. The application may be launched by selecting the installed icons.

Click Finish to exit Setup.

View Read Me  
 Launch AmiBroker

Finish

File	Version	Release date	Size	Platform	Description
<b>NEW!</b> <a href="#">AmiBroker 6.00.2 64 bit</a>	6.00.2 (6.00.2.0002)	Oct 8, 2015	10MB (10,085,000)	Windows 10 x64, Windows 8 x64, Windows 7 x64, Windows Vista x64	<b>NEW!</b> AmiBroker 6.00 official release Professional Edition, Full setup with program, help and example files. Self-Extracting EXE. <b>This universal installer supports:</b> <ul style="list-style-type: none"><li>full installation (both registered and trial)</li><li>upgrade installation</li></ul>

10  
12:10 PM  
2/23/2016

# AB installed – Main Page



# Update Quotes

The screenshot shows the AmiBroker interface for the stock symbol AA (ALCOA INC). The main window displays a candlestick chart with various technical indicators, including moving averages and Bollinger Bands. The current price is 8.6, and the volume is 13,507,700.00. The 'Tools' menu is open, and the 'Auto-update quotes (AmiQuote)' option is highlighted with a blue circle. A text box overlaid on the chart states: "There is a one-click 'auto update' to get the most recent tickers in Yahoo." The bottom status bar shows the current date and time as 12:20 PM on 2/23/2016.

Tools

- Database Purify...
- Indicator Maintenance...
- Bar Replay...
- Performance Monitor...
- Preferences...
- Save preferences
- Plug-ins...
- Customize...
- Auto-update quotes (AmiQuote)**
- Sharenet Downloader
- Cleanup database
- Update US symbol list and categories

AA - Daily 2/23/2016 Open 8.6199, Hi 8.77, Lo 8.53, Close 8.6

Short MA(Close,45) = 9.59, Long MA(Close,100) = 8.97, BBTop(Close,15,2) = 11.98, BBBot(Close,15,2) = 7.75

AA - Volume = 13,507,700.00

Run AmiQuote to update quotes in this database

X: Y: NYSE, Group 4, Basic Materials, Metal Mining | Data | 3915M | CAP

12:20 PM  
2/23/2016



# Load Historical Results

AmiBroker - [AA - ALCOA INC - Daily]

AA (Daily) x

AA - Daily 2/23/2016 Open 8.6199, Hi 8.77, Lo 8.53, Close 8.615 (-3.3%) Vol 28,265,936 MA(Close,15) = 9.87, Mid MA(Close,45) = 9.59, Long MA(Close,100) = 8.97, BBTop(Close,15,2) = 11.98, BBBot(Close,15,2) = 7.75

AmiQuote - Untitled

File Edit View Tools Help

Source: Yahoo Current (current day only, stocks, funds, US & International (50))

From: Yahoo Historical (EOD, stocks, funds, US & International (50))

Automatic: Yahoo Current (current day only, stocks, funds, US & International (50))

Automatic: Yahoo Fundamental - Basic (basic fundamental data for stocks)

Automatic: Yahoo Fundamental - Extra (extended fundamental data for stocks)

Automatic: Google Finance (EOD, US & International stocks)

Automatic: MSN Historical (EOD, stocks, funds, currency rates, US & International (10))

Automatic: Forex (Finam) (EOD, Intraday, FOREX only)

Automatic: Yahoo Intraday (Intraday, 1 last day (1min) / 5 last days (5-min), US & International)

Automatic: Google Intraday (Intraday, 15 last days (1min) / 60 last days (5min), US stocks)

Automatic: Quandl.com (Experimental, EOD)

Completed

NUM

Load history quotes as an option as well.

AA - Volume = 28,265.9

Sheet 1 Sheet 2 Sheet 3 Sheet 4 Sheet 5 Sheet 6 Sheet 7 Sheet 8

Ready X: | Y: | NYSE, Group 4, Basic Materials, Metal Mining | Data | 3920M | CAP | 12:21 PM 2/23/2016

# Setup Historical Load

The screenshot shows the AmiBroker interface with the AmiQuote dialog box open. The dialog box is titled "AmiQuote - Untitled" and has a menu bar (File, Edit, View, Tools, Help) and a toolbar. The "Source" is set to "Yahoo Historical (EOD, stocks, funds, US & International (50))". The "From" date is "1/23/1980" and the "To" date is "2/23/2016". The "Interval (Intraday)" is set to "5 min" and "Run every" is "0 min". The "Automatic import" checkbox is checked, and "Max days" is "60". A list of tickers is shown with checkboxes and "Imported" status. A blue circle highlights the date and interval settings. A text box in the center of the dialog box contains the following text:

Set historical dates and run the load.  
Note that you can load daily or  
Intraday data.

The background shows a candlestick chart for "AA (Daily)" with a price of 8.615 and a volume of 28,265.9. The status bar at the bottom indicates the date is 8/15/2013 and the time is 12:22 PM on 2/23/2016.

# Historical Load Completed

The screenshot displays the AmiBroker interface with a 'Historical Load Completed' window open. The background shows a candlestick chart for 'AA (Daily)' with a price of 8.615 and a volume of 28,265,936. The 'AmiQuote - Untitled' window is in the foreground, showing a list of tickers and their status.

AmiQuote - Untitled

Source: Yahoo Historical (EOD, stocks, funds, US & International (50))

From: 1/23/1980 To: 2/23/2016 Interval (Intraday): 5 min Run every: 0 min

Automatic import  Max days: 60

Ticker	Status
<input type="checkbox"/> AA	Imported
<input type="checkbox"/> AXP	Imported
<input type="checkbox"/> BA	Imported
<input type="checkbox"/> C	Imported
<input type="checkbox"/> CAT	Imported
<input type="checkbox"/> DD	Imported
<input type="checkbox"/> DIS	Imported
<input checked="" type="checkbox"/> EK	Error during download. Yahoo! - 404 Not Found. Either the symbol is inc...
<input type="checkbox"/> GE	Imported
<input type="checkbox"/> HD	Imported
<input type="checkbox"/> HON	Imported
<input type="checkbox"/> HPQ	Imported
<input type="checkbox"/> IBM	Imported
<input type="checkbox"/> INTC	Imported
<input type="checkbox"/> IP	Imported
<input type="checkbox"/> JPM	Imported
<input type="checkbox"/> KO	Imported
<input type="checkbox"/> MCD	Imported
<input type="checkbox"/> MMM	Imported
<input type="checkbox"/> MO	Imported
<input type="checkbox"/> MRK	Imported
<input type="checkbox"/> MFC	Imported

Completed

Sheet 1 | Sheet 2 | Sheet 3 | Sheet 4 | Sheet 5 | Sheet 6 | Sheet 7 | Sheet 8

Ready X: | Y: | NYSE, Group 4, Basic Materials, Metal Mining | Data | 3908M | CAP | 12:24 PM | 2/23/2016

# All Data from 1980 to Current





# Select SPY with which to do analysis



Pull down individual security from the list to change the chart.

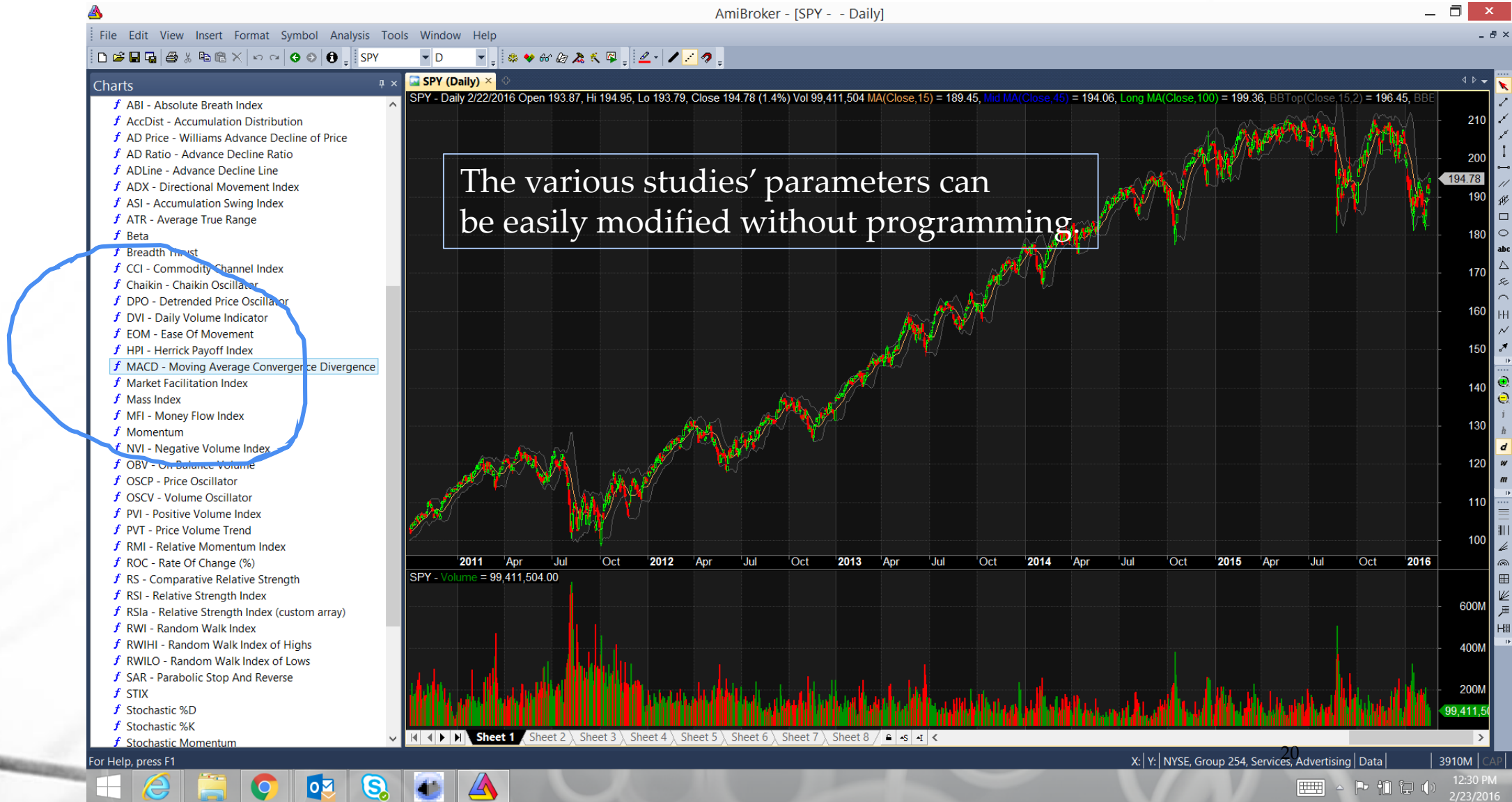
# SPY in its entirety



# Select Charts to Display



# Add MACD pane to charts



# Screen Now includes MACD pane





# Open Formula Window

AmiBroker - [SPY - - Daily]

File Edit View Insert Format Symbol Analysis Tools Window Help

SPY D

SPY (Daily) x

SPY - Daily 2/22/2016 Open 193.87, Hi 194.95, Lo 193.79, Close 194.78 (1.4%) Vol 99,411,504 MA(Close,15) = 189.45, Mid MA(Close,45) = 194.06, Long MA(Close,100) = 199.36, BBTop(Close,15,2) = 196.45, BBSBot(Close,15,2) = 182.46

We are now going to customize the chart. It is fairly straightforward. Right click and "Edit Formula".

- Parameters...
- Properties...
- Edit formula...**
- Intraday
- Daily view
- Weekly view
- Monthly view
- Pane
- Template
- Symbol Link
- Interval Link
- Delete indicator
- Delete study
- Delete all studies
- Lock symbol
- Lock interval
- Close

May Jun Jul Aug Sep Oct Nov Dec 2015 Feb Mar Apr May Sep Oct Nov Dec 2016 Feb

SPY - Volume = 99,411,504.00

SPY - MACD(12,26) = -0.67, Signal(12,26,9) = -1.85

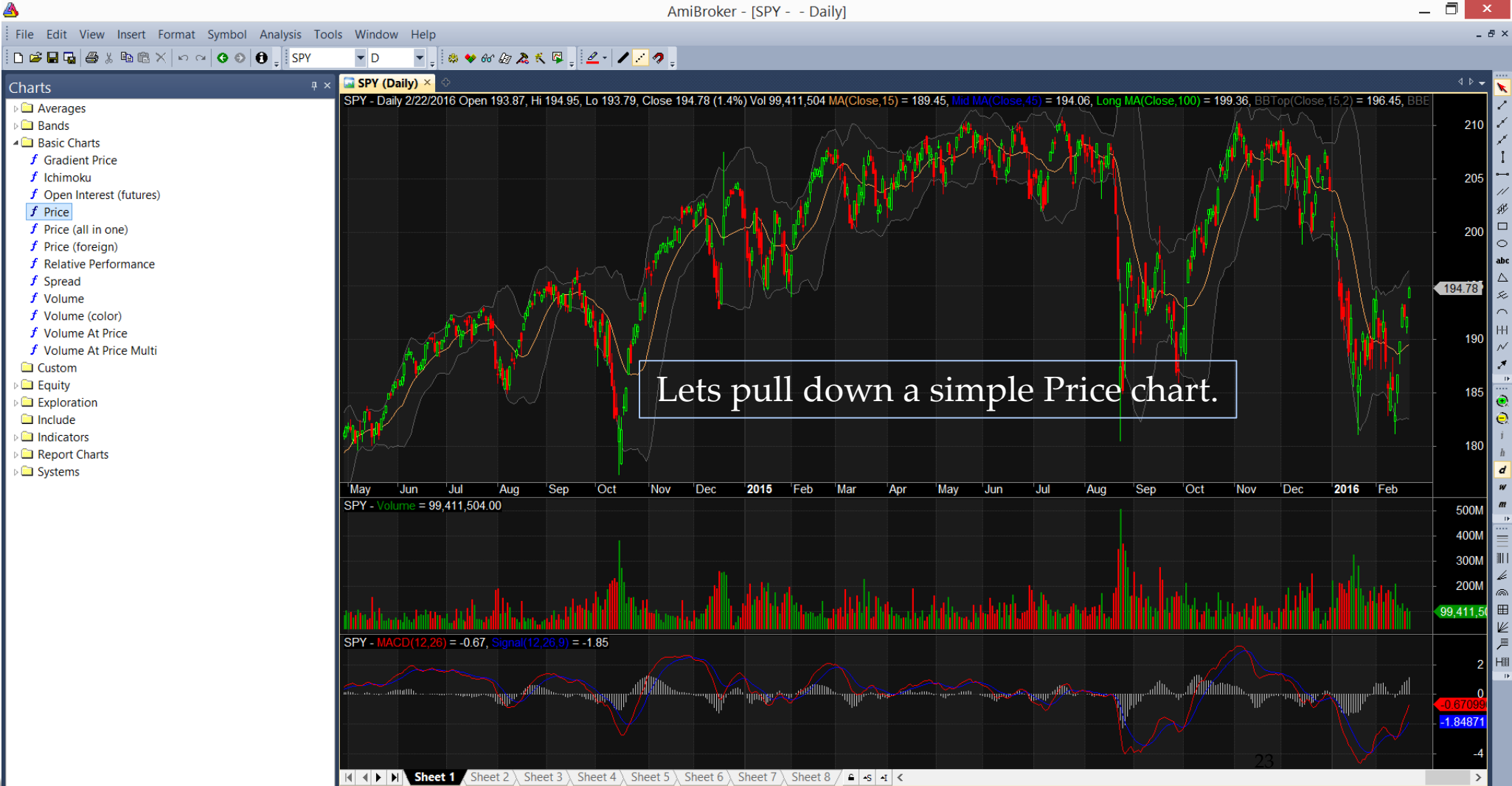
Sheet 1 Sheet 2 Sheet 3 Sheet 4 Sheet 5 Sheet 6 Sheet 7 Sheet 8

Edit formula of custom indicator

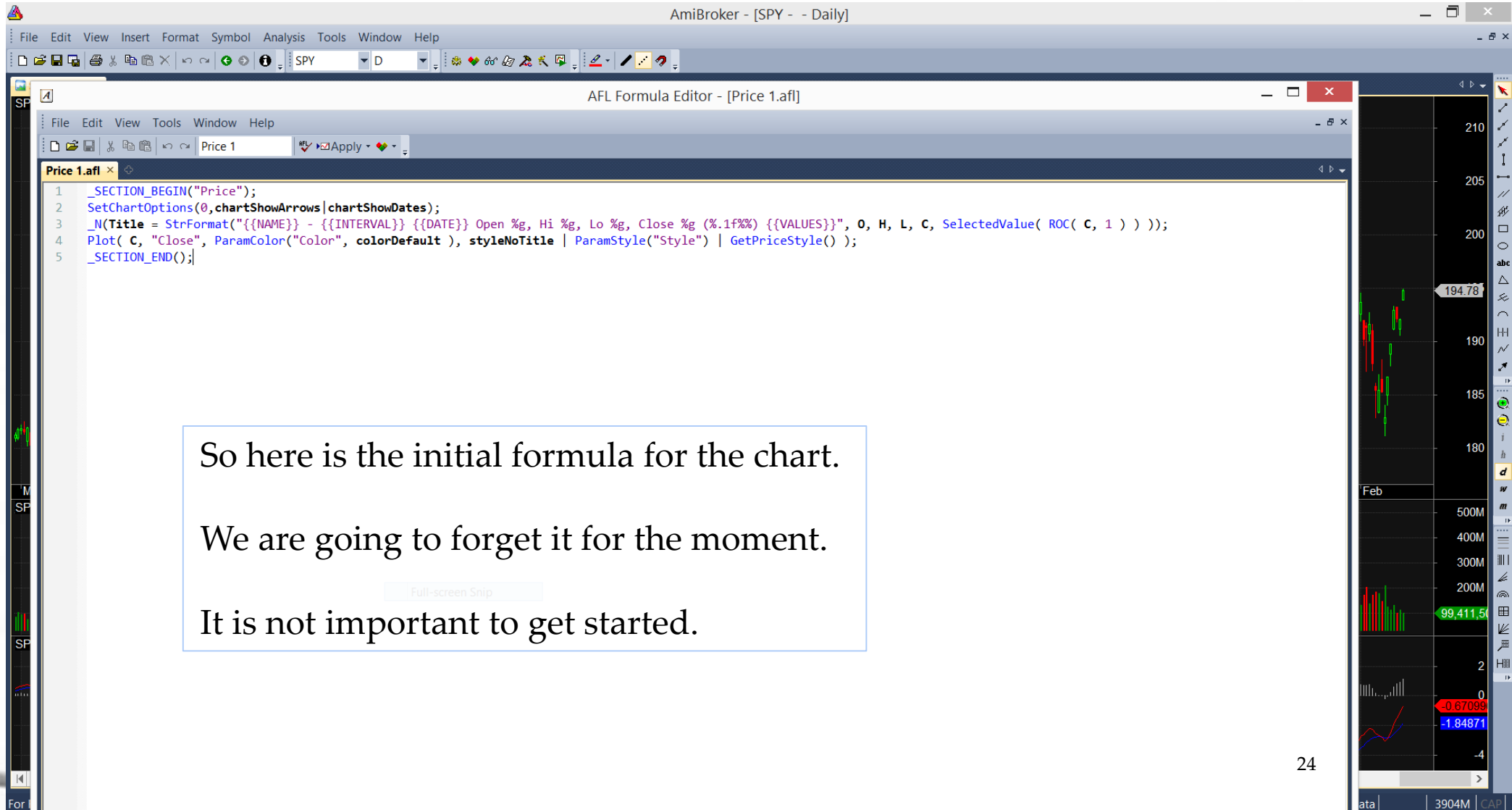
X: 5/28/2015 | Y: 194.2358 | NYSE, Group 254, Services, Advertising | Data | 3908M | CAP

12:34 PM  
2/23/2016

# Just Price Screen



# Initial Formula for the Chart



The screenshot displays the AmiBroker interface. The main window is titled "AmiBroker - [SPY - - Daily]". Below it, the "AFL Formula Editor - [Price 1.afl]" window is open, showing the following code:

```
1 _SECTION_BEGIN("Price");  
2 SetChartOptions(0,chartShowArrows|chartShowDates);  
3 _N(Title = StrFormat("#{NAME} - {INTERVAL} {DATE} Open %g, Hi %g, Lo %g, Close %g (0.1f%) {VALUES}", 0, H, L, C, SelectedValue( ROC( C, 1 ) ) ));  
4 Plot( C, "Close", ParamColor("Color", colorDefault ), styleNoTitle | ParamStyle("Style") | GetPriceStyle() );  
5 _SECTION_END();
```

To the right of the editor is a price chart for SPY. The chart shows a candlestick pattern with a price of 194.78. The y-axis ranges from 180 to 210. The x-axis shows the month of February. A volume bar chart is visible below the price chart, with a value of 99,411.5. The chart also displays a moving average line and a volume indicator.

So here is the initial formula for the chart.  
We are going to forget it for the moment.  
It is not important to get started.

# Add Two MA lines

The screenshot shows the AmiBroker interface with the AFL Formula Editor open. The code in the editor is as follows:

```
1 _SECTION_BEGIN("Price");
2 SetChartOptions(0,chartShowArrows|chartShowDates);
3 M(title = StrFormat("#{NAME} - {{INTERVAL}} {{DATE}} Open %g, Hi %g, Lo %g, Close %g (0.1f%) {{VALUES}}", 0, H, L, C, SelectedValue( ROC( C, 1 ) ) ));
4 Plot( C, "Close", ParamColor("Color", colorDefault ), styleNoTitle | ParamStyle("Style") | GetPriceStyle() );
5 _SECTION_END();
6
7 Plot( MA(C,50), "MA50", ParamColor("Color", colorlightblue ), styleLine); |
8 Plot( MA(C,200), "MA200", ParamColor("Color", colordarkblue ), styledashed);
```

A blue circle highlights lines 7 and 8 of the code. A text box on the right contains the following text:

I have added two MA lines.  
50dMA and a 200dMA.  
We will look at a crossover system

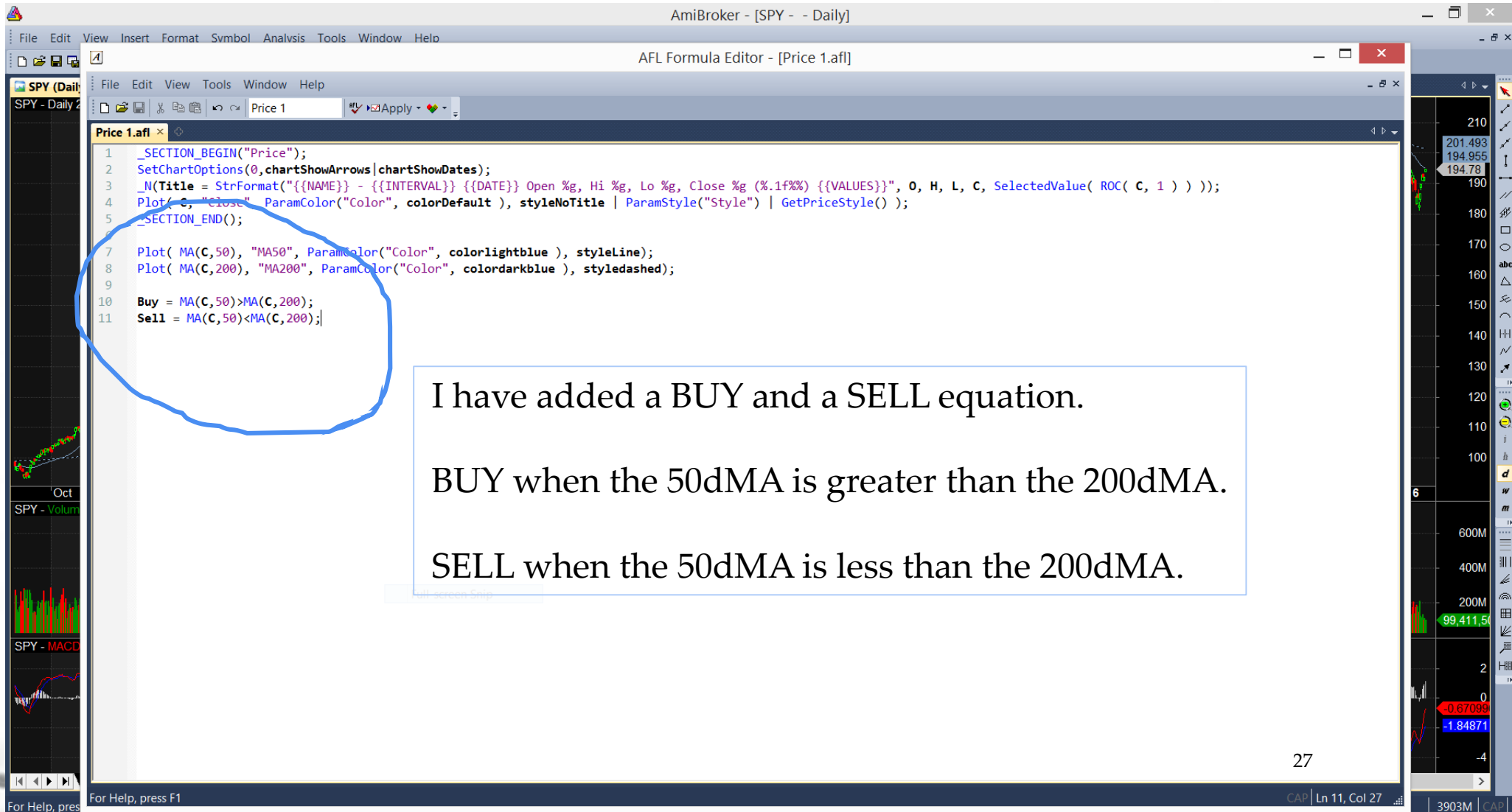
The background shows a price chart for SPY (Daily) with a volume indicator and a MACD indicator. The price is currently at 194.78.

# Result of Adding Two MA Lines





# Add BUY and SELL logic



The screenshot displays the AmiBroker interface with the AFL Formula Editor open. The code in the editor is as follows:

```
1  _SECTION_BEGIN("Price");
2  SetChartOptions(0,chartShowArrows|chartShowDates);
3  _N(Title = StrFormat("{NAME} - {INTERVAL} {DATE} Open %g, Hi %g, Lo %g, Close %g (%.1f%) {{VALUES}}", O, H, L, C, SelectedValue( ROC( C, 1 ) ) ));
4  Plot( C, "Close", ParamColor("Color", colorDefault ), styleNoTitle | ParamStyle("Style") | GetPriceStyle() );
5  _SECTION_END();
6
7  Plot( MA(C,50), "MA50", ParamColor("Color", colorlightblue ), styleLine);
8  Plot( MA(C,200), "MA200", ParamColor("Color", colordarkblue ), styledashed);
9
10 Buy = MA(C,50)>MA(C,200);
11 Sell = MA(C,50)<MA(C,200);
```

The code includes a blue circle highlighting the buy and sell logic. The buy signal is defined as  $MA(C,50) > MA(C,200)$  and the sell signal as  $MA(C,50) < MA(C,200)$ .

I have added a BUY and a SELL equation.

BUY when the 50dMA is greater than the 200dMA.

SELL when the 50dMA is less than the 200dMA.

# Open Analysis Tab



# Initial Backtest of MA Crossover Result

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position value	Cum. Profit	# bars	Profit...	MAE	MFE	Scale In/Out
SPY	Long	11/12/1993	30.8817	4/29/1994	30.2657	-1.99%	-1,994.71	-1.99%	3,238...	100,000.00	-1,994.71	116	-17.20	-5.80%	4.40%	0/0
SPY	Long	9/1/1994	32.0915	10/1/1998	72.421	125.67%	123,163.45	125.67%	3,053...	98,005.29	121,168.74	1,032	119.34	-5.51%	171.3...	0/0
SPY	Long	12/4/1998	86.7587	11/2/2000	106.853	23.16%	51,225.72	23.16%	2,549...	221,168.73	172,394.45	484	105.84	-3.91%	33.77%	0/0
SPY	Long	4/19/2002	86.1117	5/17/2002	84.6013	-1.75%	-4,777.80	-1.75%	3,163...	272,394.45	167,616.66	21	-227...	-7.07%	0.32%	0/0
SPY	Long	5/12/2003	73.6133	8/25/2004	87.877	19.38%	51,854.80	19.38%	3,635...	267,616.66	219,471.45	326	159.06	-3.47%	24.79%	0/0
SPY	Long	10/27/2004	89.6566	7/25/2006	104.032	16.03%	51,224.64	16.03%	3,563...	319,471.45	270,696.09	439	116.68	-1.56%	21.12%	0/0
SPY	Long	8/29/2006	107.252	12/28/2007	124.449	16.03%	59,438.15	16.03%	3,456...	370,696.08	330,134.24	336	176.90	-0.94%	23.43%	0/0
SPY	Long	6/18/2009	80.3602	7/7/2010	94.7676	17.93%	77,116.78	17.93%	5,352...	430,134.23	407,251.02	265	291.01	-5.13%	35.08%	0/0
SPY	Long	10/13/2010	105.879	8/17/2011	109.022	2.97%	15,060.05	2.97%	4,790...	507,251.03	422,311.07	214	70.37	-5.12%	17.45%	0/0
SPY	Long	1/23/2012	121.285	9/3/2015	193.388	59.45%	310,509.98	59.45%	4,306...	522,311.06	732,821.05	911	340.85	-2.97%	73.82%	0/0
SPY	Long	12/9/2015	204.125	1/15/2016	187.81	-7.99%	-66,565.25	-7.99%	4,079...	832,821.05	666,255.80	26	-2,560...	-8.50%	1.80%	0/0

Each trade listed.  
This formula was “long only” but it can be “long and short” or “short only”.  
“Settings” can be used to change starting principal and a number of variables.

# View Trading Report

AmiBroker - [Analysis2]

File Edit View Symbol Analysis Tools Window Help

SPY D

SPY (Daily) Analysis2

Scan Explore Backtest Optimize Formula Formulas\Custom Price 1.afl

Apply to \*Current Range All quotes View last report 10/2016 Report Explorer

Symbol	Trade	Date	Ex. Price	% chg	Profit	% Profit	Shares	Position value	Cum. Profit	# bars	Profit...	MAE	MFE	Scale In/Out
SPY	Long	11/12/1993	30.8817	-1.99%	-1,994.71	-1.99%	3,238...	100,000.00	-1,994.71	116	-17.20	-5.80%	4.40%	0/0
SPY	Long	9/1/1994	32.0915	125.67%	123,163.45	125.67%	3,053...	98,005.29	121,168.74	1,032	119.34	-5.51%	171.3...	0/0
SPY	Long	12/4/1998	86.7587	23.16%	51,225.72	23.16%	2,549...	221,168.73	172,394.45	484	105.84	-3.91%	33.77%	0/0
SPY	Long	4/19/2002	86.1117	-1.75%	-4,777.80	-1.75%	3,163...	272,394.45	167,616.66	21	-227...	-7.07%	0.32%	0/0
SPY	Long	5/12/2003	73.6133	19.38%	51,854.80	19.38%	3,635...	267,616.66	219,471.45	326	159.06	-3.47%	24.79%	0/0
SPY	Long	10/27/2004	89.6566	16.03%	51,224.64	16.03%	3,563...	319,471.45	270,696.09	439	116.68	-1.56%	21.12%	0/0
SPY	Long	8/29/2006	107.252	16.03%	59,438.15	16.03%	3,456...	370,696.08	330,134.24	336	176.90	-0.94%	23.43%	0/0
SPY	Long	6/18/2009	80.3602	17.93%	77,116.78	17.93%	5,352...	430,134.23	407,251.02	265	291.01	-5.13%	35.08%	0/0
SPY	Long	10/13/2010	105.879	2.97%	15,060.05	2.97%	4,790...	507,251.03	422,311.07	214	70.37	-5.12%	17.45%	0/0
SPY	Long	1/23/2012	121.285	59.45%	310,509.98	59.45%	4,306...	522,311.06	732,821.05	911	340.85	-2.97%	73.82%	0/0
SPY	Long	12/9/2015	204.125	-7.99%	-66,565.25	-7.99%	4,079...	832,821.05	666,255.80	26	-2,560...	-8.50%	1.80%	0/0

Result list Info Walk Forward

Display system report

X:\Y: NYSE, Group 254, Services, Advertising | Data | 3859M | CAP

6:15 PM 2/23/2016

You can get a detailed backtesting report through the pull-down.

# Backtest Results for MA Crossover

Note comparative outputs particularly between this strategy and "buy and hold"

Symbol	Trade	Date
SPY	Long	11/12/1993
SPY	Long	9/1/1994
SPY	Long	12/4/1998
SPY	Long	4/19/2002
SPY	Long	5/12/2003
SPY	Long	10/27/2004
SPY	Long	8/29/2006
SPY	Long	6/18/2009
SPY	Long	10/13/2010
SPY	Long	1/23/2012
SPY	Long	12/9/2015

	All trades	Long trades	Short trades	Buy&Hold (SPY)
Initial capital	100000.00	100000.00	100000.00	100000.00
Ending capital	766255.80	766255.80	100000.00	680998.16
Net Profit	666255.80	666255.80	0.00	580998.16
Net Profit %	666.26%	666.26%	0.00%	581.00%
Exposure %	71.61%	71.61%	0.00%	100.00%
Net Risk Adjusted Return %	930.42%	930.42%	N/A	581.00%
Annual Return %	9.22%	9.22%	0.00%	8.67%
Risk Adjusted Return %	12.88%	12.88%	N/A	8.67%
Total transaction costs	0.00	0.00	0.00	0.00
<b>All trades</b>				
	11	11 (100.00 %)	0 (0.00 %)	1
Avg. Profit/Loss	60568.71	60568.71	N/A	580998.16
Avg. Profit/Loss %	24.44%	24.44%	N/A	581.00%
Avg. Bars Held	379.09	379.09	N/A	5809.00
<b>Winners</b>				
	8 (72.73 %)	8 (72.73 %)	0 (0.00 %)	1 (100.00 %)
Total Profit	739593.56	739593.56	0.00	580998.16
Avg. Profit	92449.19	92449.19	N/A	580998.16
Avg. Profit %	35.08%	35.08%	N/A	581.00%
Avg. Bars Held	500.88	500.88	N/A	5809.00
Max. Consecutive	6	6	0	1
Largest win	310509.98	310509.98	0.00	580998.16
# bars in largest win	911	911	0	5809
<b>Losers</b>				
	3 (27.27 %)	3 (27.27 %)	0 (0.00 %)	0 (0.00 %)
Total Loss	-73337.76	-73337.76	0.00	0.00
Avg. Loss	-24445.92	-24445.92	N/A	N/A
Avg. Loss %	-3.91%	-3.91%	N/A	N/A
Avg. Bars Held	54.33	54.33	N/A	N/A
Max. Consecutive	1	1	0	0
Largest loss	-66565.25	-66565.25	0.00	0.00
# bars in largest loss	26	26	0	0
Max. trade drawdown	-107834.79	-107834.79	0.00	-253750.27
Max. trade % drawdown	-19.03	-19.03	0.00	-55.19
Max. system drawdown	-139136.40	-139136.40	0.00	-253750.27
Max. system % drawdown	-19.63%	-19.63%	0.00%	-55.19%

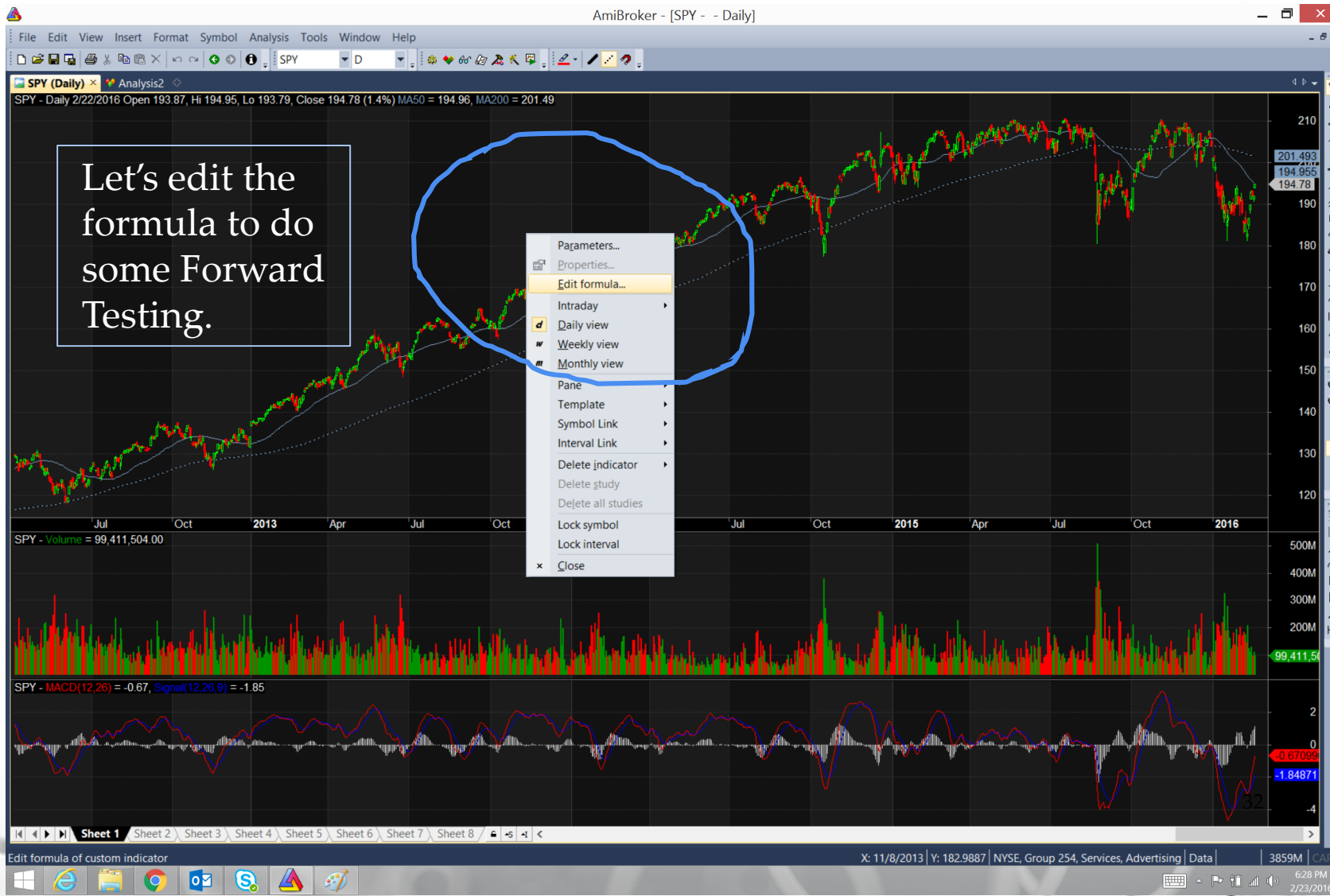
	Cum. Profit	# bars	Profit...	MAE	MFE	Scale In/Out
0	-1,994.71	116	-17.20	-5.80%	4.40%	0/0
9	121,168.74	1,032	119.34	-5.51%	171.3...	0/0
3	172,394.45	484	105.84	-3.91%	33.77%	0/0
5	167,616.66	21	-227....	-7.07%	0.32%	0/0
6	219,471.45	326	159.06	-3.47%	24.79%	0/0
5	270,696.09	439	116.68	-1.56%	21.12%	0/0
8	330,134.24	336	176.90	-0.94%	23.43%	0/0
3	407,251.02	265	291.01	-5.13%	35.08%	0/0
3	422,311.07	214	70.37	-5.12%	17.45%	0/0
6	732,821.05	911	340.85	-2.97%	73.82%	0/0
5	666,255.80	26	-2,560...	-8.50%	1.80%	0/0

NUM

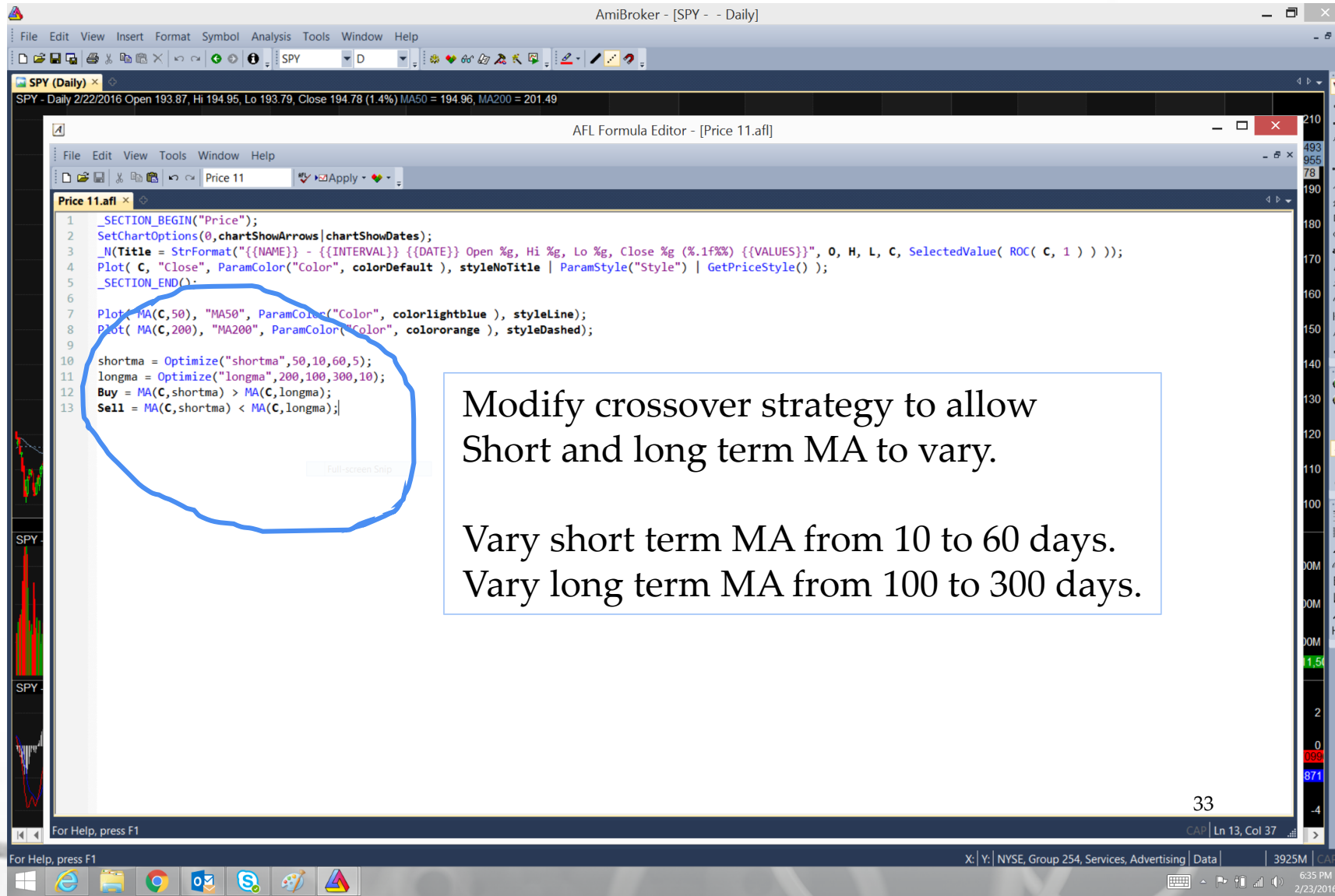
31



# Open Formula to add Optimize Steps



# Adding the Optimizing Logic



The screenshot shows the AmiBroker interface with the AFL Formula Editor open. The code in the editor is as follows:

```
1 _SECTION_BEGIN("Price");
2 SetChartOptions(0,chartShowArrows|chartShowDates);
3 _N(Title = StrFormat("{(NAME)} - {(INTERVAL)} {(DATE)} Open %g, Hi %g, Lo %g, Close %g (%.1f%) {(VALUES)}", 0, H, L, C, SelectedValue( ROC( C, 1 ) ) ));
4 Plot( C, "Close", ParamColor("Color", colorDefault ), styleNoTitle | ParamStyle("Style") | GetPriceStyle());
5 _SECTION_END();
6
7 Plot( MA(C,50), "MA50", ParamColor("Color", colorlightblue ), styleLine);
8 Plot( MA(C,200), "MA200", ParamColor("Color", colororange ), styleDashed);
9
10 shortma = Optimize("shortma",50,10,60,5);
11 longma = Optimize("longma",200,100,300,10);
12 Buy = MA(C,shortma) > MA(C,longma);
13 Sell = MA(C,shortma) < MA(C,longma);
```

A blue circle highlights lines 10, 11, and 12 of the code. A text box on the right contains the following text:

Modify crossover strategy to allow Short and long term MA to vary.

Vary short term MA from 10 to 60 days.  
Vary long term MA from 100 to 300 days.

The bottom of the screenshot shows the AmiBroker status bar with the text "For Help, press F1" and the system tray showing the time as 6:35 PM on 2/23/2016.

# Set Optimizer Settings

Optimizer is sophisticated and can optimize along a number of different variables.

Forward testing is a powerful construct that objectively proves out the potential of strategies over various periods.

The screenshot shows the AmiBroker software interface. The main window displays a table of trade data for SPY from 2000 to 2015. A 'Backtester settings' dialog box is open, showing various optimization parameters. The 'Optimization target' dropdown menu is highlighted with a blue circle, and 'Avg Bars Held' is selected. The dialog box also shows options for 'In-sample data' and 'Out-of-sample data' with their respective start and end dates and steps.

Symbol	Trade	Date	Price	Ex. date	Ex. Price	% chg	Profit	% Profit	Shares	Position value	Cum. Profit	# bars	Profit...	MAE	MFE	Scale In/Out
SPY	Long	1/3/2000	108.098	11/2/2000	106.853	-1.15%	-1,151.36	-1.15%	925.088	100,000.00	-1,151.36	213	-5.41	-9.84%	7.36%	0/0
SPY	Long	4/19/2002	86.1117	5/17/2002	84.6013	-1.75%	-1,733.81	-1.75%	1,147...	98,848.64	-2,885.17	21	-82.56	-7.07%	0.32%	0/0
SPY	Long	5/12/2003	73.6133	8/25/2004						97,114.83	15,932.31	326	57.72	-3.47%	24.79%	0/0
SPY	Long	10/27/2004	89.6566	7/25/2006						115,932.30	34,521.10	439	42.34	-1.56%	21.12%	0/0
SPY	Long	8/29/2006	107.252	12/28/2007						134,521.11	56,090.49	336	64.19	-0.94%	23.43%	0/0
SPY	Long	6/18/2009	80.3602	7/7/2010						156,090.48	84,075.23	265	105.60	-5.13%	35.08%	0/0
SPY	Long	10/13/2010	105.879	8/17/2011						184,075.23	89,540.34	214	25.54	-5.12%	17.45%	0/0
SPY	Long	1/23/2012	121.285	9/3/2015						189,540.33	202,220.63	911	123.69	-2.97%	73.82%	0/0
SPY	Open Long	12/9/2015	204.125	12/31/2015						302,220.62	201,842.79	17	-22.23	-2.62%	1.80%	0/0

# Forward Testing Optimizer Results

AmiBroker - [Analysis1]

File Edit View Symbol Analysis Tools Window Help

SPY D

SPY (Daily) Analysis1

Scan Explore Backtest Optimize Formula Formulas\Custom\Price ATAS.af

Apply to \*Current Range From-To dates 1/ 1/2000 1/ 1/2016

Mode	Begin	End	No.	Net Profit	Net % Profit	Exposure %	CAR	RAR	Max. Trad...	Max. Trad...	Max. Sys ...	Max. Sys % Draw...	Recovery Factor	CAR/MDD	RAR/MDD	shortma	longma	Profit Factor
IS	1/1/2000	12/31/2004	101	30,801.26	30.80	48.96	5.52	11.27	-12,106.35	-11.44	-12,106.35	-11.44	2.54	0.48	0.99	15	190	13.24
OOS	1/1/2005	12/31/2006	1	10,717.39	10.72	92.45	5.26	5.69	-8,262.66	-7.59	-10,528.11	-9.67	1.02	0.54	0.59	15	190	3.77
IS	1/1/2001	12/31/2005	141	40,349.80	40.35	50.56	7.02	13.89	-9,462.84	-7.53	-9,462.84	-7.53	4.26	0.93	1.84	50	220	N/A
OOS	1/1/2006	12/31/2007	1	21,812.96	19.70	100.00	9.45	9.45	-14,002.75	-9.92	-14,002.75	-9.92	1.56	0.95	0.95	50	220	N/A
IS	1/1/2002	12/31/2006	141	62,588.49	62.59	70.37	10.23	14.53	-11,396.20	-7.59	-11,396.20	-7.59	5.49	1.35	1.91	50	220	N/A
OOS	1/1/2007	12/31/2008	1	96.96	0.07	50.60	0.04	0.07	-15,986.61	-10.76	-15,986.61	-10.76	0.01	0.00	0.01	50	220	N/A
IS	1/1/2003	12/31/2007	160	75,774.60	75.77	92.69	11.95	12.89	-18,195.96	-9.92	-18,195.96	-9.92	4.16	1.20	1.30	35	240	N/A
OOS	1/1/2008	12/31/2009	1	20,253.34	15.27	22.38	7.37	32.96	-8,501.01	-5.67	-8,501.01	-5.67	2.38	1.30	5.81	35	240	N/A
IS	1/1/2004	12/31/2008	160	44,332.45	44.33	79.51	7.61	9.58	-14,941.11	-9.92	-14,941.11	-9.92	2.97	0.77	0.97	35	240	N/A
OOS	1/1/2009	12/31/2010	1	24,745.39	16.19	59.52	7.81	13.12	-30,366.14	-15.70	-30,576.94	-15.81	0.81	0.49	0.83	35	240	N/A
IS	1/1/2005	12/31/2009	84	62,655.55	62.66	67.51	10.23	15.15	-13,258.34	-9.92	-13,258.34	-9.92	4.73	1.03	1.53	40	170	N/A
OOS	1/1/2010	12/31/2011	1	-13,552.21	-7.63	64.48	-3.92	-6.07	-34,341.95	-17.31	-34,341.95	-17.31	-0.39	-0.23	-0.35	40	170	0.00
IS	1/1/2006	12/31/2010	148	65,944.80	65.94	63.30	10.67	16.86	-22,555.82	-13.40	-22,555.82	-13.40	2.92	0.80	1.26	30	230	N/A
OOS	1/1/2011	12/31/2012	1	951.13	0.58	80.08	0.29	0.36	-30,627.10	-17.31	-31,093.89	-17.57	0.03	0.02	0.02	30	230	1.06
IS	1/1/2007	12/31/2011	74	39,121.22	39.12	56.98	6.84	12.00	-19,933.32	-13.40	-19,933.32	-13.40	1.96	0.51	0.90	45	160	N/A
OOS	1/1/2012	12/31/2013	1	84,256.55	51.06	100.00	22.97	22.97	-17,861.88	-9.69	-17,861.88	-9.69	4.72	2.37	2.37	45	160	N/A
IS	1/1/2008	12/31/2012	62	54,879.58	54.88	58.54	9.14	15.62	-17,090.69	-13.40	-17,090.69	-13.40	3.21	0.68	1.17	40	150	7.13
OOS	1/1/2013	12/31/2014	1	115,591.54	46.37	100.00	21.05	21.05	-25,794.95	-7.27	-25,794.95	-7.27	4.48	2.89	2.89	40	150	N/A
IS	1/1/2009	12/31/2013	62	125,082.22	125.08	77.34	17.63	22.79	-18,772.46	-13.40	-18,772.46	-13.40	6.66	1.32	1.70	40	150	N/A
OOS	1/1/2014	12/31/2015	1	11,756.41	3.22	87.10	1.60	1.84	-51,974.66	-11.91	-66,867.66	-15.32	0.18	0.10	0.12	40	150	2.51
IS	1/1/2010	12/31/2014	29	95,499.43	95.50	82.35	14.37	17.45	-14,459.73	-13.40	-14,459.73	-13.40	6.60	1.07	1.30	40	120	120.08
IS	1/1/2011	12/31/2015	18	65,728.29	65.73	81.72	10.64	13.03	-11,938.16	-9.69	-13,693.55	-9.69	4.80	1.10	1.34	40	110	20.24

Note difference in "in sample" and "out of sample" results.  
This is why forward testing is important.

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Result list Info Walk Forward

Open a document X: Y: NYSE, Group 254, Services, Advertising | Data | 3855M | CAP 6:49 PM 2/23/2016

# Takeaways

- Amibroker is fairly easy to set up but able to handle complex concepts
- Backtesting is doable and should be done before you use real money
- Forward testing is required if you want to see how a strategy will behave

If you are not rigorously testing your strategies, particularly as they might behave in a recessionary downturn, now is a time to start.

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