

# Lesson 6

## Strategy Testing, Optimization and Automation

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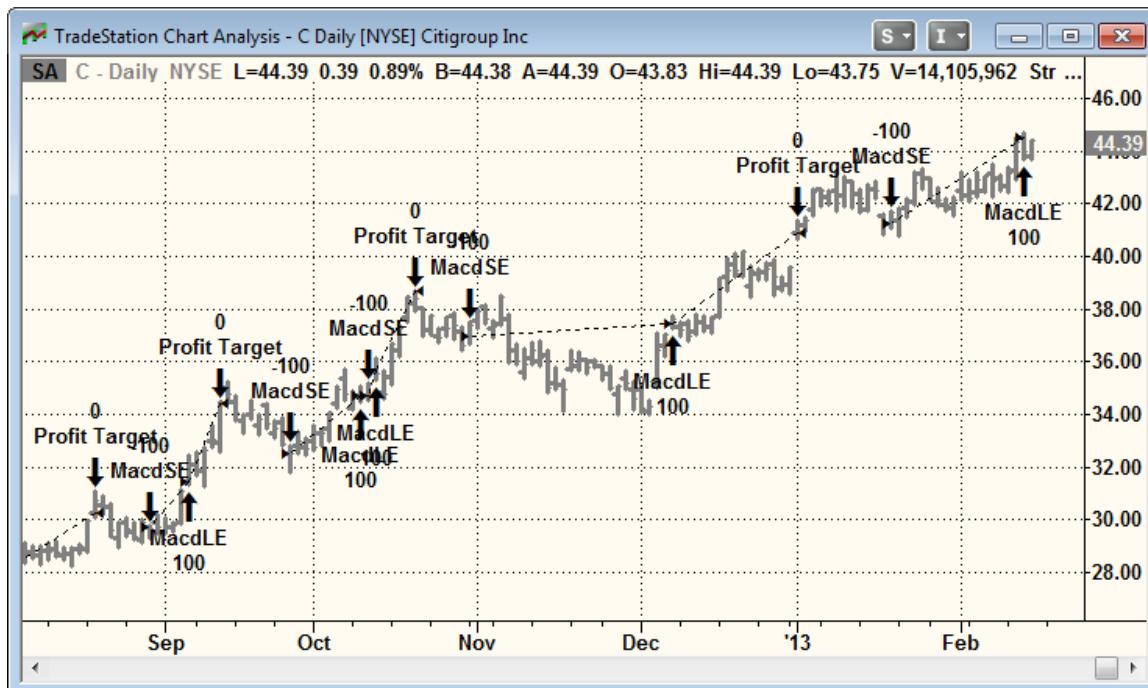
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### Strategy Trading

Strategy trading is using a set of trading rules to systematically enter and exit the market, typically based on technical indicators. TradeStation can also employ strategies based on fundamental data for stocks.

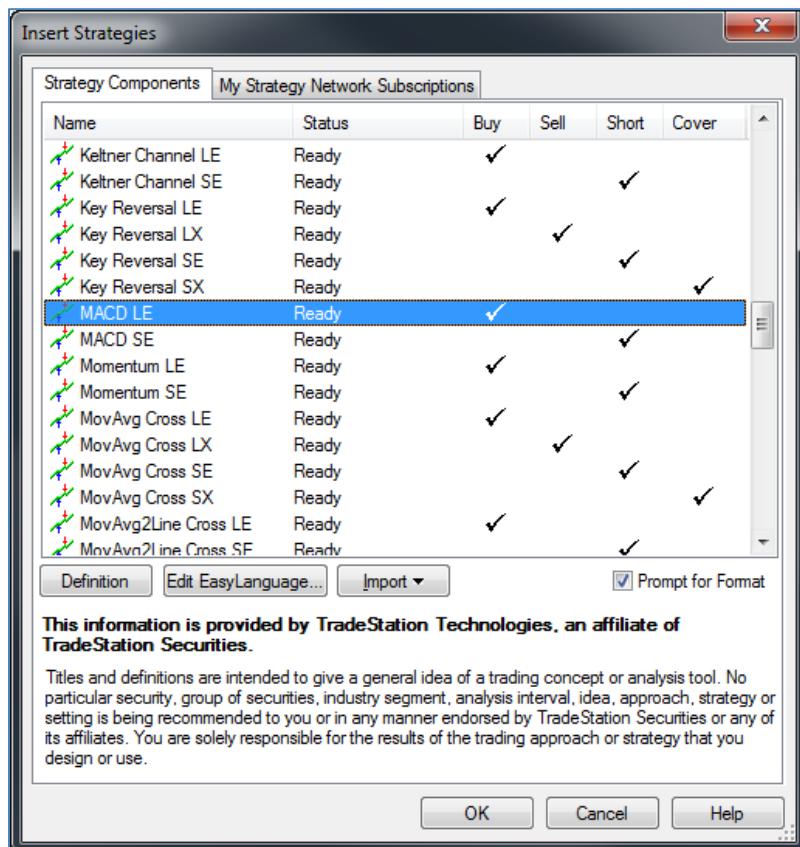
Strategy testing in TradeStation is done in Chart Analysis windows. Strategies or groups of strategies may be inserted into charts for the purpose of testing historical performance, monitoring current activity and, eventually, automating real-time order entry and execution.

When a strategy or group of strategies is inserted into a Chart Analysis window, the entries and exits are shown as up and down arrows on the chart. The chart also identifies the names of the entries and exits, as well as the net open position at the close of any bar on which there would have been a trade. A dotted line connects entries and exits to display the profitability of the trade.



## Using Strategy Components

Dozens of strategy components, based on most of the standard technical indicators and many fundamental data fields, are supplied with TradeStation. This allows you to test many of the indicators you already use every day. In addition, there are exit strategies for stop loss, profit targets, trailing stops and many others. Together, these allow you to build and test complex strategies by combining different strategy components.



To access the TradeStation built-in strategies, click on the **Insert – Strategy** menu sequence. This will display the **Insert Strategies** dialog. You may also right-click on the background of a Chart Analysis window and click on **Insert Strategy...** from the right-click menu to access the same dialog.

In the **Strategy Components** tab, strategies are listed in alphabetical order and a checkmark is displayed under Buy, Sell, Short, or Cover, based on the order action that it generates.

To view a synopsis of the strategy and information on how to format it, select the strategy and click on the **Definition** button. This will open **TradeStation Help** directly on the topic describing the strategy.

All supplied strategies are written in EasyLanguage and the

formulas may be viewed, copied or modified. From the **Insert Strategies** dialog, select the strategy and click on the **Edit EasyLanguage...** button. This will open the TradeStation Development Environment and the EasyLanguage document for that specific strategy.

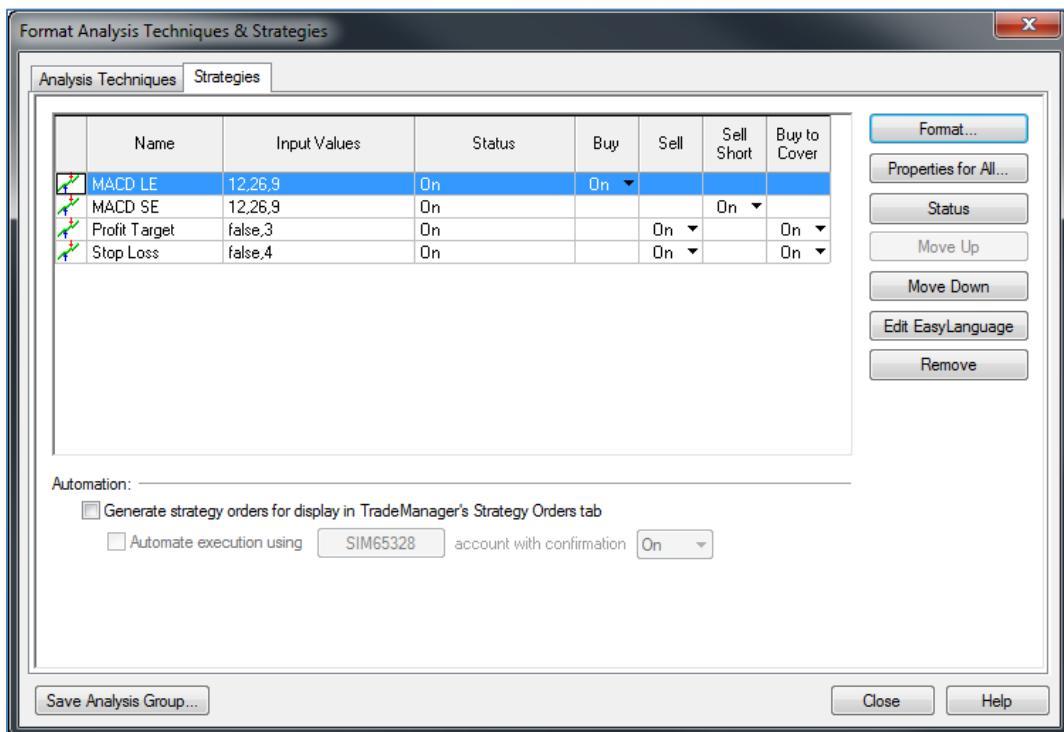
Click on the **Import** button if you wish to import a strategy from the TradeStation TradingApp Store or from a third-party EasyLanguage File Document (ELD). If you have strategies imported from the TradeStation TradingApp Store, you may find these products by selecting the **TradingApp Store Subscriptions** tab at the top of the dialog.

**Note:** In a Chart Analysis window containing multiple symbols, strategies are always applied to the first symbol that was plotted in the Chart Analysis window, known as Data1. The strategy can reference other symbols on the chart, but orders will be generated only for Data1.

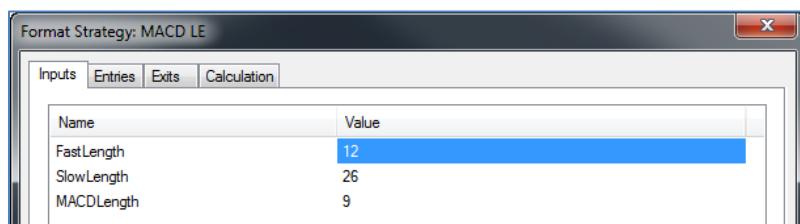
## Formatting Strategies

To format strategies, click on the **Format – Strategies...** menu sequence and the **Format Analysis Techniques & Strategies** dialog will appear displaying all strategies. The parameters used in the calculation of the strategy are listed in the **Input Values** column. Also, the columns **Buy**, **Sell**, **Sell Short** and **Buy to Cover** display the order action that the strategy generates. You may click on the dropdown to change the specific order action or turn it off.

The **Status** button on this dialog allows you to turn off any strategy component that you wish to disable without removing it from the Chart Analysis window; clicking **Status** a second time will enable it. The **Remove** button will remove the highlighted strategy from the list.

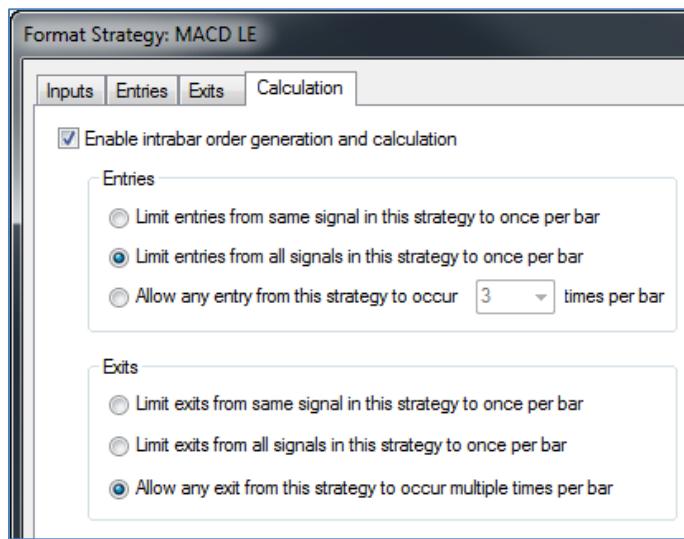


Each strategy applied to a Chart Analysis window has its own **Format Strategy** dialog, containing an **Inputs** tab. This allows you to test each strategy with different input values. On the **Format Analysis Techniques & Strategies dialog**, select the strategy you wish to format and click on the **Format...** button.



In the **Format Strategy** dialog, click on the **Inputs** tab to make changes to the inputs of that specific strategy.

Click on the **Entries** and **Exits** tabs to format the color and style of strategy signals and labels.



By default, strategies are calculated at the close of the bar and orders are generated and remain active for the duration of the following bar.

Click the **Calculation** tab and select **Intraday order generation and calculation** to change the default calculation of the strategy. With intrabar order generation enabled, the strategy engine can evaluate conditions and criteria every tick during a bar and can generate orders as soon as the conditions or criteria are met. Select the calculation method that best fits your trading strategy.

Click on **OK**, and then select another strategy from the **Format Analysis Techniques and Strategies** dialog if you wish to format any of its settings.

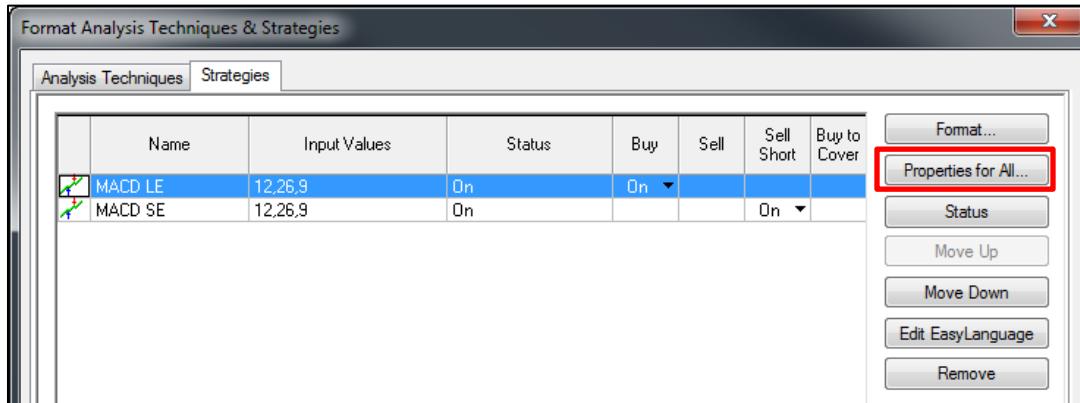
## Setting Strategy Properties

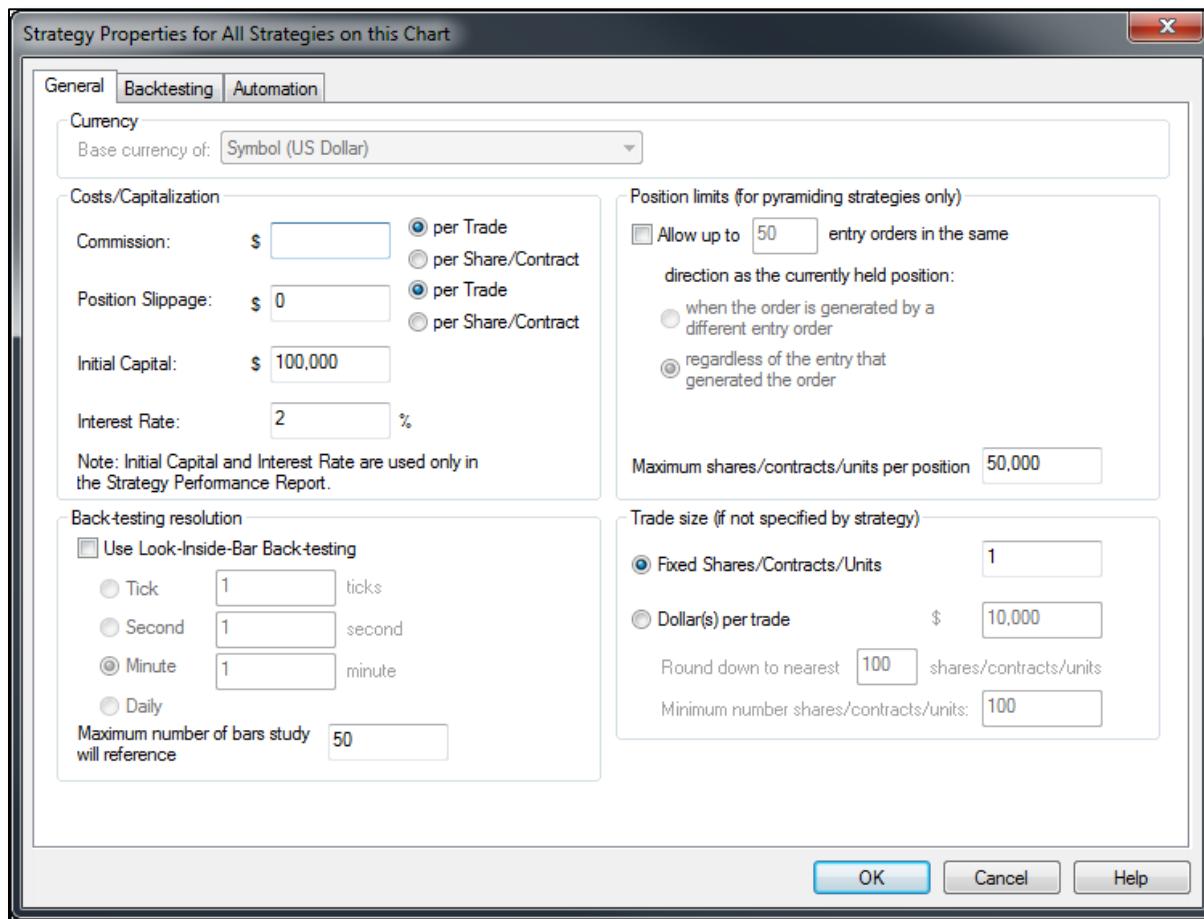
From the **Format Analysis Techniques & Strategies** dialog, click on the **Properties for All...** button.

The **General** tab allows you to set such properties as commission and slippage amounts to be used in your back-testing. You may also set the initial capital and interest rate to be used in the Strategy Performance Report, increase the back-test resolution, enable pyramiding and adjust the trade size.

Some assumptions are made when filling orders using historical data. The **Backtesting** tab allows you to modify the behavior of these historical strategy-filled orders.

When automating a strategy, your strategy orders and positions may not always match your real trading account. The **Automation** tab provides settings to allow your strategy orders and positions to be synchronized with your real account orders and positions.



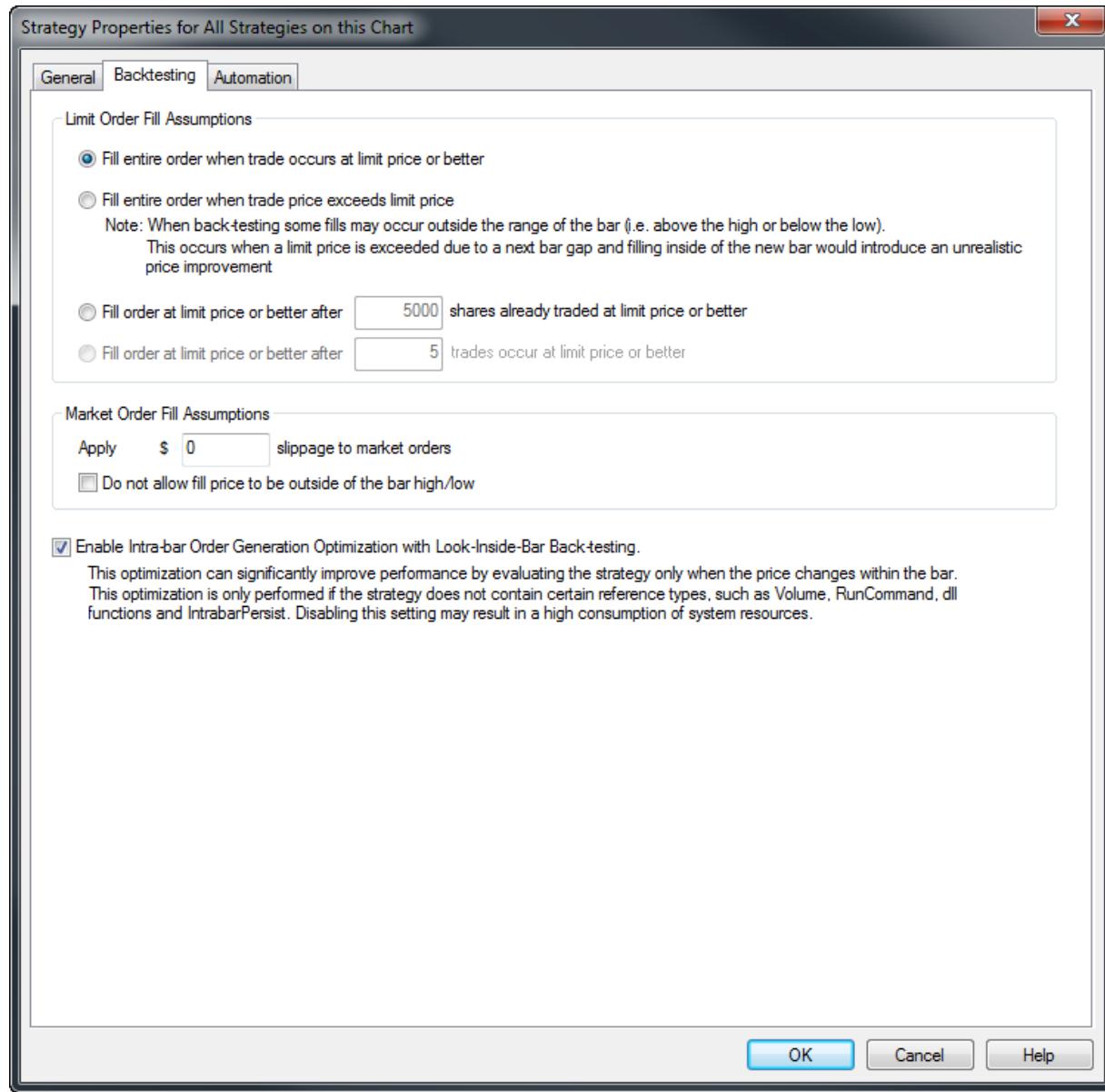


**Commission and Position Slippage** amounts can be entered **per Trade or per Share/Contract**. **Initial Capital** and **Interest Rate** are values that are used to calculate performance measures in the Strategy Performance Report.

By default, when analyzing historical data in a chart to determine if a strategy would have generated a signal, the strategy only uses the open, high, low and close prices of a bar. Generally, assumptions are made in regard to the direction of the price when the bar opens. To allow the strategy to calculate using more data points and avoid assumptions, check the “**Use Look-Inside-Bar Back-testing**” checkbox. Depending on the data interval of the chart, you may select **Daily**, **Minute**, **Second** or **Tick** to increase the back-testing resolution.

Strategies will only take one trade in one direction at a time. For example, if a strategy is in a long position it will not generate another long entry until it is flat or in a short position. You may check the “**Allow up to ‘50’ entry orders in the same direction as the currently held position:**” checkbox to enable pyramiding. This way the strategy may trade again using the same or different entry order and increase your position size as the strategy criteria is met.

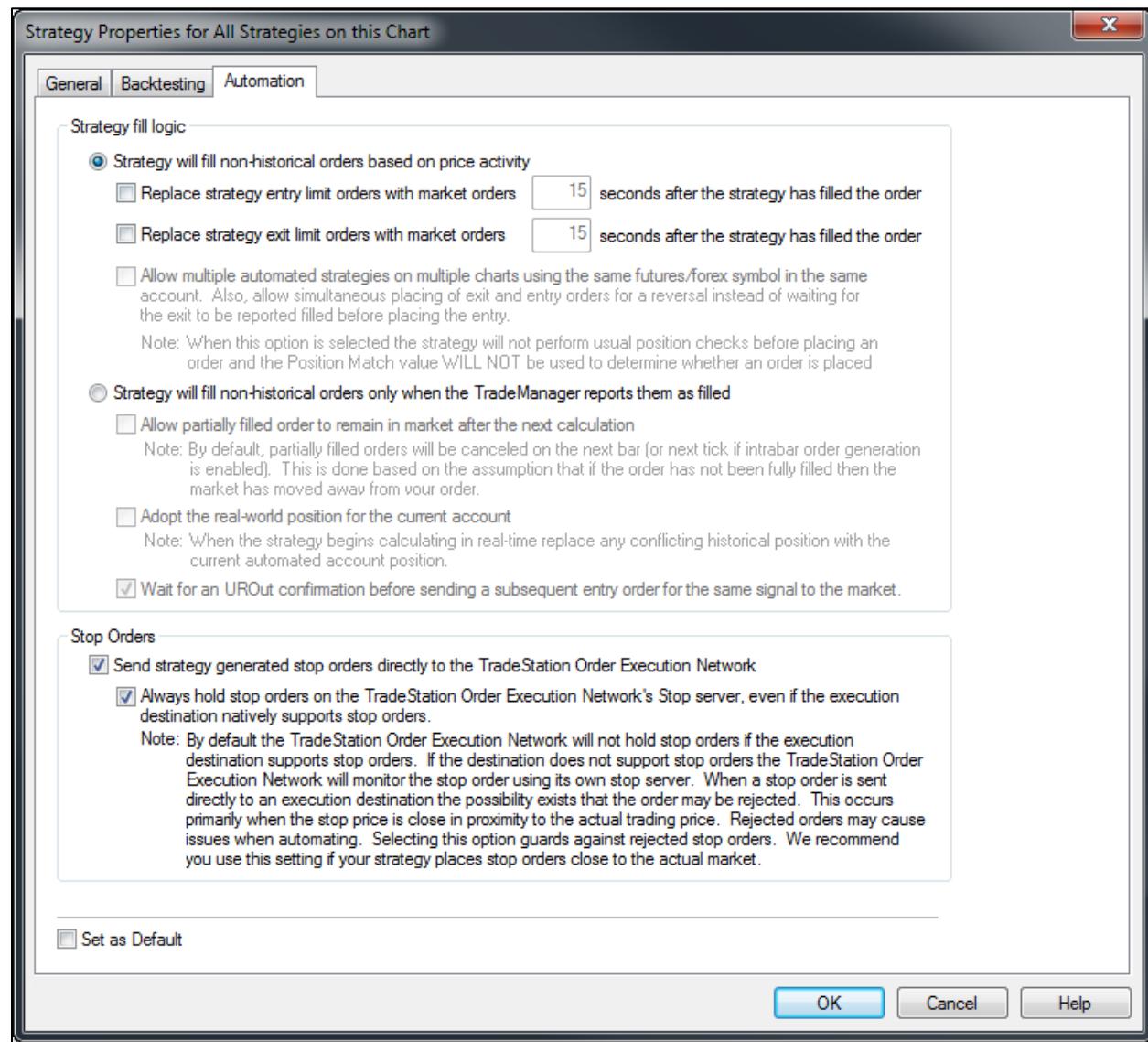
You may also adjust the strategy trade size by entering the quantity in the box next to **Fixed Shares/Contracts** or a dollar amount if using the **Dollar(s) per trade** option.



In a historical back-test, a strategy will always assume a perfect fill; market orders are filled immediately at the next available tick and limit orders are filled at the specified limit price. Under real market conditions, this may not always be the case.

To provide a more realistic order fill, you may set limit orders to fill only when the limit price has been exceeded, a specific number of shares have been traded or a specific number of trades have occurred.

You may also add slippage to market orders.



An automated strategy fills orders independently of what happens to the order in the real world. This may cause differences between actual fill prices and strategy fill prices. Also, a strategy may assume a fill while the order remains unfilled in the real world. To address these issues, select the appropriate radio buttons and checkboxes on this dialog to allow strategy orders to be filled based on feedback from the TradeStation trade server.

By default, stop orders are held and managed by the TradeStation platform running on your computer. When the stop price is reached, the strategy engine sends a market order. For stop orders to be managed and triggered by the TradeStation trade server, check the **"Send strategy generated stop orders directly to the TradeStation Order Execution Network"** checkbox.

## Strategy Performance Report

The Strategy Performance Report provides a detailed view of how well a strategy might have performed for the period and on the data being tested.

It contains a series of tabbed pages that allow you to view detailed and summarized reports, graphs and analysis of all the trades that would have been generated by the strategy's criteria.

	All Trades	Long Trades	Short Trades
Total Net Profit	\$16,780.00	\$14,807.00	\$1,973.00
Gross Profit	\$53,398.00	\$31,760.00	\$21,638.00
Gross Loss	(\$36,618.00)	(\$16,953.00)	(\$19,665.00)
Profit Factor	1.46	1.87	1.10
Total Number of Trades	35	17	18
Percent Profitable	40.00%	41.18%	38.89%
Winning Trades	14	7	7
Losing Trades	21	10	11
Even Trades	0	0	0
Avg. Trade Net Profit	\$479.43	\$871.00	\$109.61
Avg. Winning Trade	\$3,814.14	\$4,537.14	\$3,091.14
Avg. Losing Trade	(\$1,743.71)	(\$1,695.30)	(\$1,787.73)
Ratio Avg. Win:Avg. Loss	2.19	2.68	1.73
Largest Winning Trade	\$12,401.00	\$8,844.00	\$12,401.00
Largest Losing Trade	(\$5,918.00)	(\$5,918.00)	(\$4,125.00)
Max. Consecutive Winning Trades	3	3	2
Max. Consecutive Losing Trades	4	4	3
Avg. Bars in Winning Trades	20.57	20.29	20.86
Avg. Bars in Losing Trades	8.76	9.40	8.18
Avg. Bars in Even Trades	0.00	0.00	0.00

The Strategy Performance Report can be accessed by clicking on the **View – Strategy Performance Report** menu sequence.

It can also be accessed by clicking the Strategy Performance Report button from the toolbar. The Strategy Performance Report is only available when a strategy has been applied to a Chart Analysis window.

## Back-Testing Using Portfolio Maestro

TradeStation's Portfolio Maestro is a back-testing tool that lets you evaluate the performance of a group of strategies applied to a basket of symbols that make up your portfolio. The performance is based on the trades generated by the rules in your strategies along with other money management and ranking criteria that you specify. Portfolio Maestro also includes a range of reporting and analysis features to help you optimize your portfolio.



Portfolio Maestro is installed and runs separately from the TradeStation platform. Once installed, a Portfolio Maestro icon is displayed on your computer's desktop.

The **Manage Strategy Groups** icon on the left shortcut bar allows you to group strategies and symbols together. Click on the **New** button at the top left to create a new Strategy Group and then click on the **Add Strategy** button in the **Strategies** tab to add strategies and the **Add Symbol List** button in the **Symbol Lists** tab to add symbols.

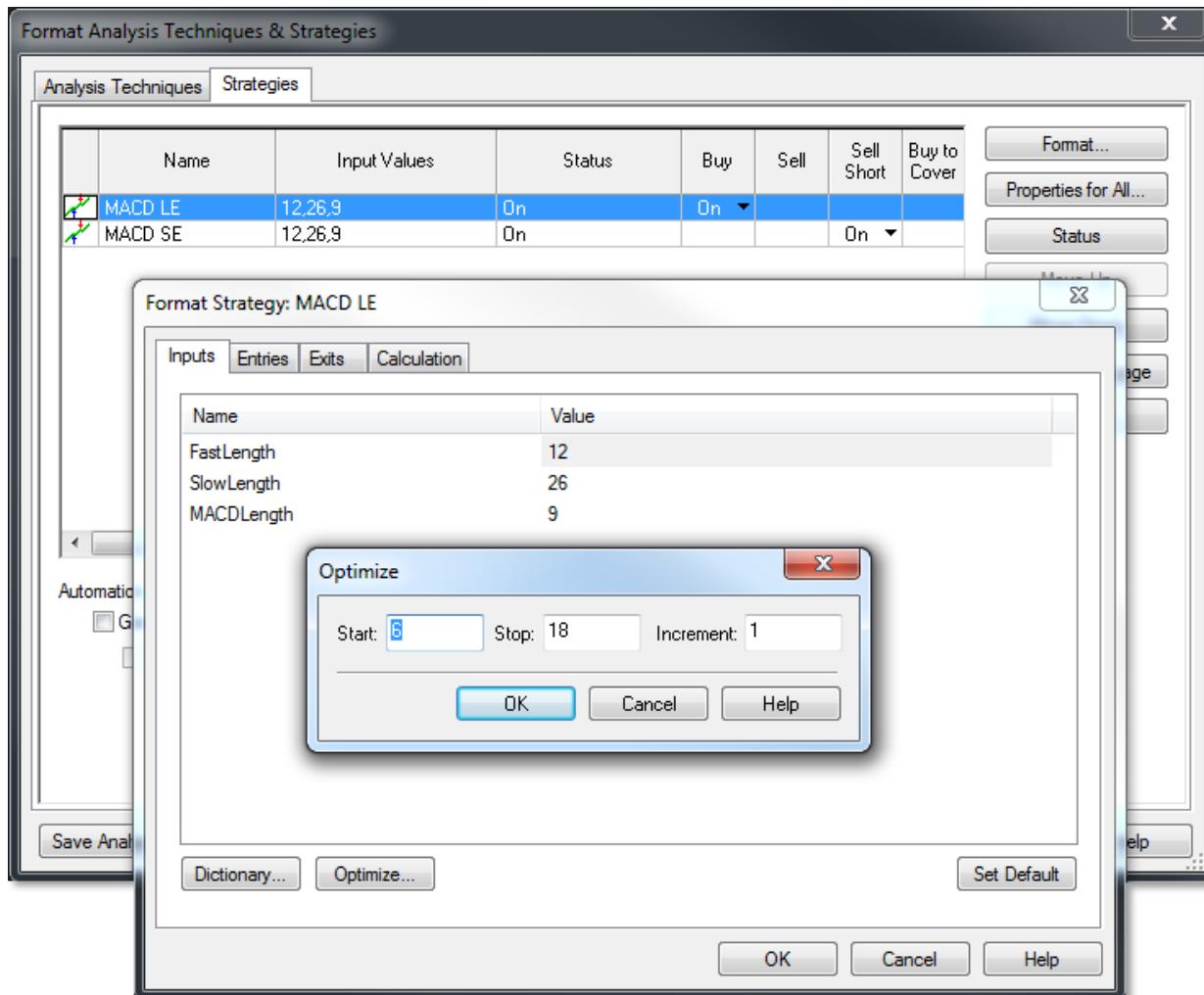
Click on the **Manage Portfolios** icon on the left shortcut bar and click on the **Add Strategy Group** button to add a group or groups of strategies and symbols lists. Once all strategies and symbols are included in the portfolio, click on the **Backtest Portfolio** button at the top right.

Click on the **Report** and **Analysis** tabs at the bottom of the shortcut bar to view performance reports and analysis graphs of the portfolio.

The screenshot shows the TradeStation - Portfolio Maestro interface. On the left, there is a sidebar with icons for 'Portfolios', 'Manage Portfolios', 'Manage Strategy Groups', 'Reports', and 'Analysis'. The main area has a title bar 'Portfolio: NYTE' and a toolbar with buttons for 'Add Strategy Group', 'Remove Strategy Group', 'Portfolio Settings', and 'Backtest Portfolio'. Below the toolbar is a table for 'NYTE' strategy group, listing 'Strategy Name' (ATR Trailing LX, ATR Trailing SX, Bollinger Bands LE, Bollinger Bands SE) and 'Description' (Strategy Group - Intraday - 5 minute bars). To the right of the table is a 'Performance Report: Backtest 00003' section. This report includes a table of variables and a detailed analysis table. The analysis table has columns for 'Symbol' (AAPL, ADBE, ADP, ADSK, AKAM, ALTR, ALXN), 'Variables' (Portfolio Total, ADSK, AVG0, EXPD, MRVL, ROST), and several rows of data such as 'Total Return', 'Gross Profit', 'Gross Loss', 'Open Trade P/L', and various statistical metrics like 'Number of Trades', 'Standard Deviation', and 'Average Trade Length'.

## Strategy Optimization

Optimization is the process of testing a range of input values for the purpose of fine-tuning a trading strategy. TradeStation's optimization feature allows you to test a range of values for any number of numeric inputs simultaneously. TradeStation will then generate a Strategy Optimization Report displaying results from these tests.



To optimize inputs in a strategy, go to the **Format Strategy** dialog for the specific strategy you wish to optimize, click on one of the numeric inputs, and then click on the **Optimize...** button. In the **Optimize** dialog, select the range of inputs to test and the increment to be used in stepping through the range of input values.

Once the optimization is complete, you may view an Optimization Report by clicking on the **View – Strategy Optimization Report** menu sequence. This option is only available after running an optimization.

## Walk-Forward Optimizer

TradeStation's Walk-Forward Optimizer divides the historical data in a Chart Analysis window to be tested as separate runs. Each run is further divided into two parts, an in-sample and an out-of-sample data segment. Strategy parameters are optimized using the in-sample data segment, and the optimal

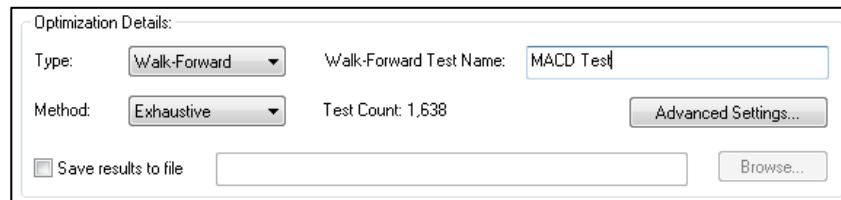
parameters selected are applied to the out-of-sample data segment. The strategy performance results from the out-of-sample data segments are compiled in a report, and these metrics determine the usability of the strategy.

Each run is subjected to **Test Criteria** and is given a pass or fail score based on the specified thresholds.

The screenshot shows a grid-based interface for 'Rolling Walk-Forward Analysis'. The columns represent months 1 through 12. The rows are divided into 'In Sample' and 'Out of Sample' segments. The first four months (1-4) are labeled 'In Sample Month 1-4' and 'Out of Sample #1'. The next four months (5-8) are labeled 'In Sample Month 2-5' and 'Out of Sample #2'. The following four months (9-12) are labeled 'In Sample Month 3-6', 'In Sample Month 4-7', 'In Sample Month 5-8', 'In Sample Month 6-9', 'In Sample Month 7-10', and 'In Sample Month 8-11', each corresponding to an 'Out of Sample' segment labeled #3 through #8. Below the grid, there is a legend: 'Realistic results from out-of-sample trades on unseen data' followed by eight green boxes labeled 'Out of Sample #1' through '#8'. A dropdown menu at the bottom left says 'Type: Rolling WFA with % based Out-Of-Sample'. To the right, there are tabs for 'Performance Summary', 'Sensitivity Analysis', and 'Distribution Analysis'. Below these tabs, it says 'Matrix Average: PASS', 'Tests per WFA: 3913', and has a '3D view' checkbox.

To run a walk-forward optimization, select **Walk-Forward** under **Optimization Details** before clicking on the **Optimize** button to optimize a strategy and enter a name in the **Walk-Forward Test Name**

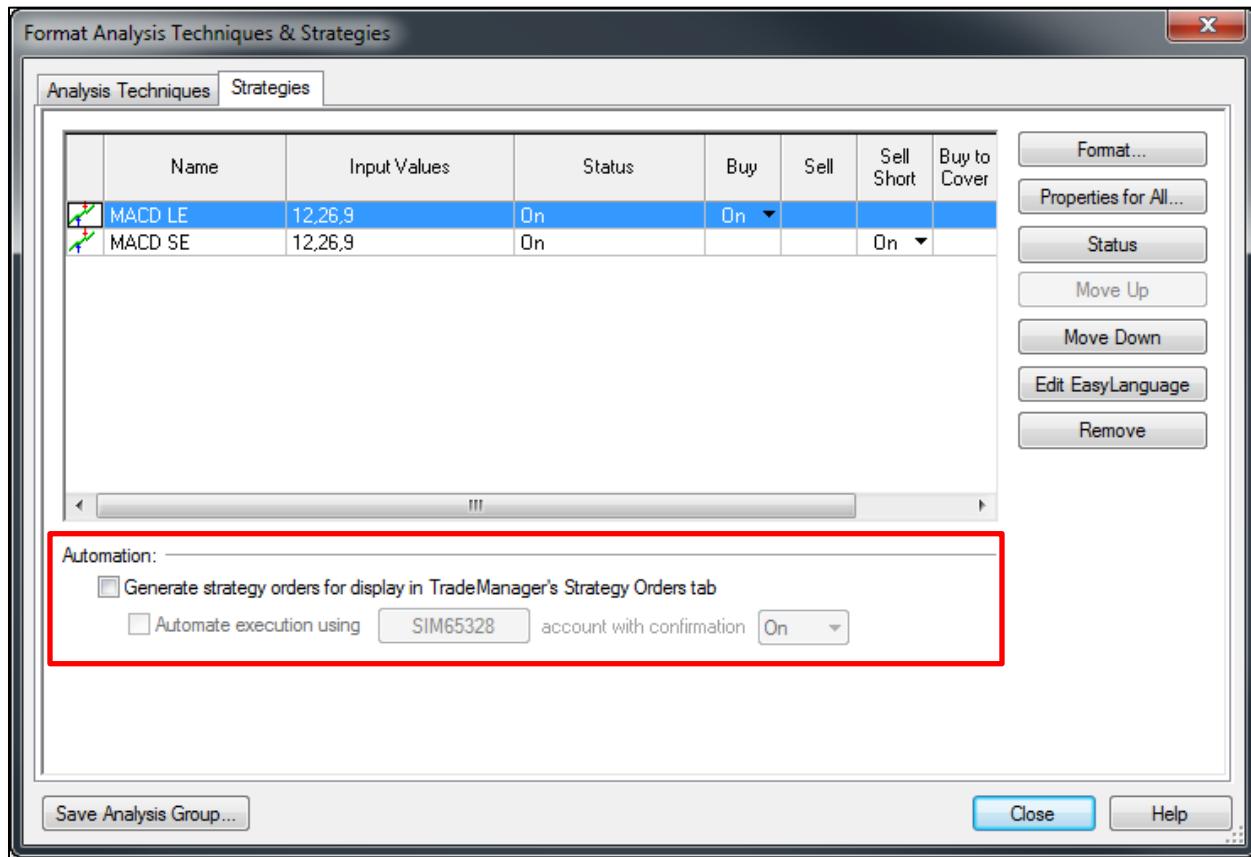
field. Once the optimization is complete, click on the **Walk-Forward Optimizer** button in the TradingApps Launcher. In the Walk-Forward Optimizer, click on the **File – Open Walk-Forward Test** menu sequence, select a Walk-Forward test and click on **Open**. Then click on the **Walk-Forward Analysis – Start Cluster Analysis (Multiple WFA's)** menu sequence.



Information is organized in different tabs showing you optimization summaries for in-sample segments, walk-forward summaries for out-of-sample segments, the test results used in qualifying the different runs and a series of different graphs such as P/L history, sensitivity and distribution analysis.

## Strategy Automation

A strategy is considered automated when you apply the strategy, or group of strategies, to a live Chart Analysis window and enable at least the first automation checkbox. As new data is collected, the corresponding strategy orders are automatically generated.



To automate the execution of your strategy orders, click on the **Format – Strategies...** menu sequence. At bottom of the **Format Analysis Techniques & Strategies** dialog, you will find the automation checkboxes.

TradeStation has two “levels” of strategy automation:

- **Generate strategy orders for display in TradeManager's Strategy Orders tab.**  
This checkbox, used alone, will track hypothetical positions and create a real-time log of orders in the TradeManager window, but will not send orders to the market for execution.
- **Automate execution using 1234567 account with confirmation On/Off**  
This checkbox authorizes orders to be sent to the market for execution in the account you designate. Confirmation **On** requires that you authorize each order before it is placed.

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