Optimization of Trading Systems [1]

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See Also: Trading System Tools [2] See Also: Trading System Deployment / Trading System Indicator [3]

Optimization pertains to the ability to determine the combination of trading system parameters which results in the most favorable performance for that trading system. These optimization parameters include a variety of technical indicator periods, periodicity, stops, targets, and more. The ability to use technical indicator periods (along with stops and targets) as optimization parameters is implemented in Investor/RT through User Variables (V# variables). The setup windows for certain technical indicators, e.g. moving averages, now accept a V# variable in place of an explicit number as a period. For example, the setup for a moving average can specify that the period of the moving average be V#5. When the moving average is evaluated as part of a trading signal, the period of the moving average will be obtained from user variable V#5. For instance, if V#5 was placed in the "Period" field of a Moving Average, and the value of V#5 for the corresponding symbol was 12, then a 12 period moving average would result. When the moving average preferences are viewed, the user will see "V#5" in the Period field. This concept is key to understanding optimization. By specifying certain technical indicator settings as variables in trading signals, the optimal value of those variables can be determined by the optimization feature. Each optimization allows up to 8 V# variables to be used as parameters. Up to 6 are "stepped" parameters, while 2 can have "discrete" values. A stepped parameter has a format such as: V#1 from 5 to 9 step 1 If this were the only parameter, the optimization would set V#1 to 5, run the trading system and record the results, set V#1 to 6, run the system again and record the results, and so on. The system would be run 5 times in this example. The results would then be sorted (ranked) by a user-specified measure and displayed. A discrete parameter has a format such as V#2 – 5, 8, 13, 21 If both V#1 from the previous example and V#2 were used as parameters in the same optimization, the trading system would be executed once for every possible combination of V#1 and V#2, which in this case would be 5 x 4 = 20 iterations. Periodicity can also be used as an optimization parameter. Periodicity may be expressed as either a "stepped" or "discrete" parameter. Periodicities of "Minutes", "Seconds", or "Ticks" may be used. As an example, if we added the periodicity as a stepped parameter with the following settings to the optimization discussed above "Minutes from 1 to 10 step 1", the optimization would now run 5 x 4 x 10 = 200 iterations of the trading system, and provide the combination of V#1, V#2, and periodicity that resulted in the best performance. The optimization results are displayed in tabular form. One column is displayed for each of the optimization parameters, along with columns for each of the desired results. Options for displayed results include:

- Avg Profit/Trade
- Avg % Gain/Trade
- Avg %Gain/Bar
- Gross Profit

- Net Profit
- Avg Win/Avg Loss
- % Profitable
- # Trades

Below these options is a "Sort by" selection list containing the same choices. The option chosen from this list will be used when sorting the results. As a simple example, a moving average crossover system looks to enter a long position when a shorter term moving average crosses above a longer term moving average, and to exit the long position when the short term average falls below the long term average. In this trading system, there are two candidates for optimization parameters: the short term MA period and the long term MA period. This system will also involve a "stop", and will be optimized across a variety of "Minute" periodicities. First the trading system must be created. Choose File: New: Trading System from menu bar. Give the trading system a name like "maCrossTS". The buy and sell signals will be created using three V# variables. These will in turn be used as optimization parameters along with periodicity. Click the "New" button next to "Signal:". Type in the following syntax for the buy signal…

MA_ST > MA_LT AND MA_ST.1 <= MA_LT.1

MA_ST will be the short term MA, while MA_LT will be the longer term MA. This signal detects when the shorter term MA crosses above the longer term MA (MA_ST is above MA_LT on the current bar, but was less than or equal to MA_LT on the previous bar). Click the "Save" button. Specify a Period of V#1 for MA_ST, and V#2 for MA_LT. Give the signal a name like "maCrossBuy". Add a second signal for setting (and adjusting) the trailing stop. This signal will be used in a "no action" (NONE) rule in the trading system. The signal has the following syntax, and should be given a name like "maCrossSetStop"...

SET(STOP, CL – V#3)

STOP is a token used to hold trailing stop values during backtesting. The signal above will set a trailing stop at the closing price minus the value of V#3 during the execution of the system. As discussed later, V#3 will be used as an optimization parameter, varying the trailing stop from 2 cents to 10 cents. Now, setup the exit signal using syntax similar to the buy signal:

CL <= STOP OR (MA#1 < MA#2 AND MA#1.1 >= MA#2.1)

Save this signal with a name like "maCrossExit". The system will exit if the stop is reached or the crossover occurs. Now that the signals are created, return to the Trading System window. Create the following three rules: If maCrossBuy then BUY 1000 at Last price If maCrossSetStop then NO ACTION If maCrossExit then SELL 1000 at Last price The periodicity is not really important here since the optimization will automatically set it. Click the "Setup Backtest" button at the bottom. In this window, specify the symbol or quotepage that you'd like to test, along with the backtesting period. Remember, the longer the viewing period, and the more symbols that are tested, the longer the optimization will take to execute. Also make sure the "Maximum position size for longs" is at least 1000 shares. Now, click OK at the bottom of this "Backtest Setup" window, and click "Save" in the Trading System window. This trading system should now be ready to be optimized on V#1 (short term MA period), V#2 (long term MA period), V#3 (stop), and periodicity. Choose "Setup: Optimization" from the menu bar to open the Optimization Setup window. Click on "New" and provide a name for the optimization setup, e.g. "maCrossOpt". For the trading system, choose the "maCrossTS" created earlier. For this example, setup the V#1 parameter (short term MA period) from 4 to 12 step 1, the V#2 parameter (long term MA period) from 13 to 22 step 1, the V#3 parameter (trailing stop distance) from 0.02 to 0.10 step 0.01, and the

periodicity from 1 minute to 10 minutes step 1 minute. Check three of the stepped user variable parameters, and the one stepped periodicity option and fill in the proper values. On the right, checkmark the desired results along with the measure by which the table will be sorted. Each row of the table will represent an iteration/execution of the trading system. To begin the optimization, click the "Optimize" button at the lower left corner of the window. The title bar of the optimization window provides feedback as the optimization progresses. The title updates after each iteration is completed and looks something like this: (Esc key to stop) 10% (820/8200) [4,19,0.04,2] ~2:45 left [last 0.124, avg. 0.098] This tells the user that the optimization is 10% complete, completed 820 of the 8200 iterations, currently testing the combination of [V#1=4, V#2=19, V#3=0.04, Periodicity = 2], there are approximately 2 minutes and 45 seconds left, the last iteration gave a result of 0.124 (based on what is specified in "Sort by") and the average result of the completed iterations is 0.093. The optimization can be terminated at any time by hitting the escape (Esc) key on the keyboard. If the optimization is interrupted, the results of the completed iterations will still be shown. As of the Investor/RT 6.3 Beta 2, the following technical indicator periods have been augmented to allow V# variables in period setup boxes.

- **Beta 2**
- ADX (DX Period)
- ADX (Smoothing Period)
- ADXR (DX Period)
- ADXR (ADXR Period)
- ADXR (Smoothing Period)
- Bear Power (Moving Average Period)
- Bull Power (Moving Average Period)
- BOP (Smoothing Period)
- DI+/- (DI Interval)
- LRA (MA Period)
- LRA (Regression Period)

- LRS (MA Period)
- LRS (Regression Period)
- T3 (Period)
- True Range (Smoothing Period)
- True Range (Actual Range Period)
- Volatility (Period)
- Williams %R - WPR (Period)
- Zig Zag (Min. Price Change %)
- Zig Zag (Ref. Line %)
- Zig Zag Oscillator (Min. Price Change %)
- Zig Zag Oscillator (Ref. Line %)
- **Beta 1**
- BB (Moving Avg Period)
- BB (Standard Deviations)
- CCI (CCI Period)
- CCI (Smoothing Period)
- EMA (Period)
- EMA (Shift Period)

- LRF (MA Period)
- LRF (Regression Period)
- LRF (Forecast Period)
- LRF (Standard Deviations)
- MA (Period)
- MA (Shift Period)
- MACD (Short)
- MACD (Long)
- MACD (Signal)
- PNF (Reversal Criteria)
- PNF (Box Size)
- RSI (RSI Period)
- RSI (Smoothing Period)
- RSI (Momentum Period)
- STOCH (Raw K Period)
- STOCH (Fast D Period)
- STOCH (Slow D Period)
- TLB (Reversal Criteria)

- TLBOSC (Reversal Criteria)
- Volume (Period)

Indicators not in the list above can, of course, be used with trading systems, but their indicator settings will remain constant as the trading system is optimized.

Optimizing Symbols A checkbox has been added to the Optimization window titled "Optimize Symbols". When checked, the symbols themselves will become optimization parameters. This feature is applicable only when the underlying Trading System is setup to backtest on a quotepage (as opposed to a single symbol). Each optimization iteration will run on a single symbol instead of a quotepage of symbols. The results will provide a column for "symbol" just as it does for any other optimization parameter. As an example, the sorted results may show that the combination of MSFT using V#1 of 10 and V#2 of 12 was the most favorable. In addition, the optimization will leave any optimized V# variables for each symbol with their optimal values for that symbol. In other words, V#1 for MSFT might be 10, while V#1 for INTC might be 13, etc. This gives the user the ability to optimize the values on a symbol by symbol basis, giving each symbol an independent set of optimized V# parameters that yields the most favorable trading results for that symbol.

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