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Kirkland, July 14<sup>th</sup>, 2022

Hello Travis,

Please find our report on porting the mean-reversion strategy to AmiBroker attached.

Thank you,  
Best regards.

Felix Bertram

## Note:

In a previous version of this report, we achieved results that seemed too good to be true – and they were. We have since isolated the issue with the code. As stated previously, AmiBroker's custom backtest procedure is very finicky and allows a wide range of coding errors that would not be easily possible on other platforms. In particular, the custom backtest procedure allows access to future signal values, resulting in data snooping. Due to a coding error of this nature, we executed trailing stops one day in advance of stocks dropping, which resulted in exaggerated results.

## Overview

The objective of this phase was to port the mean-reversion strategy developed in phase #08 of this project to AmiBroker. In a perfect world, there would be no differences between the AmiBroker and TuringTrader implementations, both having identical behavior and leading to identical results. However, unfortunately, the AmiBroker platform is limiting, especially when aiming for clean and maintainable code. Therefore, we used a slightly different approach, implementing the features we could, and leaving out those that caused us troubles. Afterwards, we re-optimized the parameters to reflect the changes in the strategy's logic.

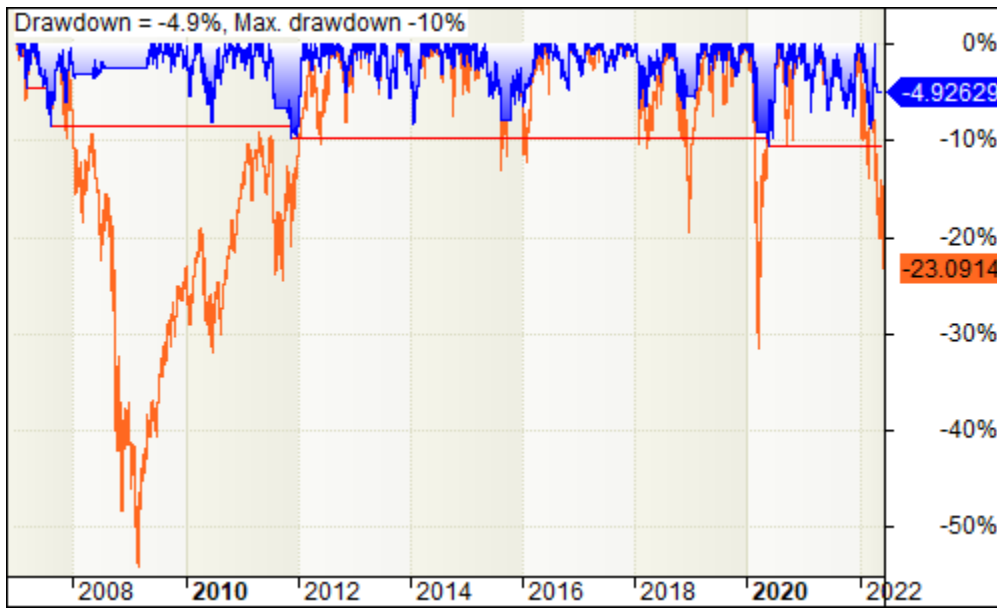
There are the following differences between the implementations on TuringTrader and AmiBroker:

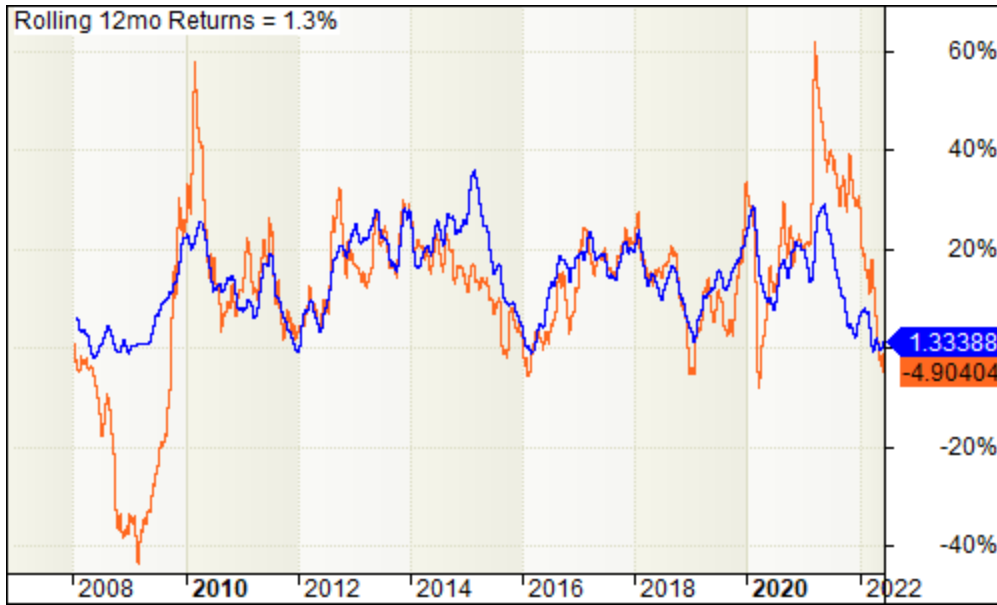
- On TuringTrader, we pre-filtered the universe for low volatility before looking for stocks meeting the entry requirements. This filter should prevent the strategy from picking high-volatility stocks when none of the stocks with low-volatility meet the entry parameters. On AmiBroker, we do not pre-filter. All stocks meeting the entry criteria are ranked by volatility, and then picked from the top.
- On TuringTrader, the strategy enters bond positions when the market-regime filter signals bearish parameters, and all open stock positions have been closed. On AmiBroker, we stay in cash.

## Results

As disappointing as the differences in the strategy logic may appear, the results are very similar to those achieved with TuringTrader. While the annual performance is about 3% lower, we assume that this is related to the missing bond strategy as a safe instrument.

Statistics	
	<b>All trades</b>
Initial capital	100000.00
Ending capital	659788.97
Net Profit	559788.97
Net Profit %	559.79%
Exposure %	75.89%
Net Risk Adjusted Return %	737.66%
Annual Return %	12.98%
Risk Adjusted Return %	17.11%
Transaction costs	9185.22
<hr/>	
<b>All trades</b>	484
Avg. Profit/Loss	1156.59
Avg. Profit/Loss %	2.51%
Avg. Bars Held	39.84
<hr/>	
<b>Winners</b>	279 (57.64 %)
Total Profit	924127.01
Avg. Profit	3312.28
Avg. Profit %	6.79%
Avg. Bars Held	55.88
Max. Consecutive	10
Largest win	21215.23
# bars in largest win	107
<hr/>	
<b>Losers</b>	205 (42.36 %)
Total Loss	-364338.12
Avg. Loss	-1777.26
Avg. Loss %	-3.33%
Avg. Bars Held	18.01
Max. Consecutive	10
Largest loss	-12541.27
# bars in largest loss	16
<hr/>	
Max. trade drawdown	-105461.62
Max. trade % drawdown	-100.00
Max. system drawdown	-59850.21
Max. system % drawdown	-10.43%
Recovery Factor	9.35
CAR/MaxDD	1.24
RAR/MaxDD	1.64
Profit Factor	2.54
Payoff Ratio	1.86
Standard Error	49460.16
Risk-Reward Ratio	0.78
Ulcer Index	3.21
Ulcer Performance Index	2.36
Sharpe Ratio of trades	0.61
K-Ratio	0.06





Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr%
2007	-0.2%	2.5%	1.3%	4.3%	0.4%	-3.1%	-2.4%	1.0%	3.6%	1.8%	-2.3%	1.8%	8.8%
2008	-2.2%	0.0%	0.0%	0.0%	0.5%	-0.1%	0.4%	-0.2%	0.0%	0.0%	0.0%	0.0%	-1.5%
2009	0.0%	0.0%	0.0%	0.0%	3.3%	3.3%	2.0%	1.6%	1.2%	0.9%	5.0%	2.7%	21.8%
2010	-1.2%	0.4%	3.4%	-0.6%	-3.1%	-3.2%	4.9%	-0.5%	4.4%	2.7%	-0.8%	2.6%	9.0%
2011	-2.1%	2.7%	0.1%	5.1%	2.1%	-1.0%	-1.4%	-3.7%	0.0%	-0.2%	-2.3%	-0.5%	-1.4%
2012	7.3%	1.3%	3.3%	0.8%	-1.5%	5.7%	2.8%	0.6%	2.1%	-1.0%	-0.3%	-0.0%	22.7%
2013	5.1%	3.6%	2.2%	2.8%	0.7%	-0.1%	3.6%	-4.0%	2.0%	6.3%	3.6%	2.3%	31.8%
2014	-6.1%	1.7%	6.1%	3.6%	3.2%	2.9%	-2.0%	2.3%	1.0%	3.2%	3.9%	1.6%	22.9%
2015	2.7%	2.7%	-0.6%	-0.3%	0.4%	-2.3%	3.5%	-5.9%	0.0%	4.0%	0.2%	0.1%	4.2%
2016	-0.5%	0.3%	2.6%	3.5%	2.4%	4.9%	0.5%	0.2%	-1.6%	-1.2%	3.8%	1.7%	17.8%
2017	-0.9%	5.8%	1.2%	0.2%	3.6%	0.2%	1.0%	-0.4%	2.2%	1.1%	4.5%	0.5%	20.5%
2018	2.3%	-1.4%	-1.0%	2.3%	1.3%	-2.3%	5.0%	1.0%	-0.2%	-2.7%	1.8%	-2.3%	3.6%
2019	0.0%	4.6%	2.4%	4.1%	-2.0%	3.1%	1.3%	3.0%	3.8%	-1.9%	2.1%	1.9%	24.3%
2020	2.4%	-4.2%	-1.4%	0.0%	2.4%	-1.0%	9.5%	3.6%	0.8%	0.7%	3.7%	2.2%	19.7%
2021	-0.9%	-3.2%	7.5%	0.1%	1.0%	-4.2%	3.6%	-0.8%	-3.1%	1.1%	-2.5%	9.1%	7.1%
2022	1.1%	-4.3%	-3.0%	3.3%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	-3.1%
Avg	0.4%	0.8%	1.5%	1.8%	0.9%	0.2%	2.2%	-0.1%	1.1%	1.0%	1.4%	1.6%	

The charts and metrics are benchmarked against the S&P-100 index (\$OEXTR). We can see that the strategy is overall outperforming its benchmark, while at the same time showing much lower drawdowns. However, the strategy's 12-months rolling returns seem trail the benchmark in 2021. Further research is required to fully understand this shortfall. However, as this was a period of sustained growth, we can assume that momentum-based strategies would have picked this up.

## Log Output

Following this strategy follows a number of operations:

- Opening positions to the required position size
- Closing positions based on falling out of the top ranks, hitting the trailing stop, or not meeting the performance objective
- Trimming down positions, especially in times of rising volatility
- Switching to the risk-off strategy

Of these four operations, only the first two can easily be seen in AmiBroker's results list. We therefore implemented additional log output, which provides clear instructions:

Log window	
Message	
4/22/2022, VZ: exit position (trailing stop)	
4/22/2022, T: reduce position to 16.6667%	
4/22/2022, VZ: exit position (trailing stop)	
4/22/2022, CVS: exit position (trailing stop)	
4/25/2022, CL: reduce position to 16.6667%	
4/25/2022, T: reduce position to 15.7948%	
4/26/2022, CL: reduce position to 16.6667%	
4/26/2022, T: exit position (trailing stop)	
4/26/2022, WBA: exit position (trailing stop)	
4/29/2022, CL: exit position (trailing stop)	
4/29/2022: hold safe instrument	
5/2/2022: hold safe instrument	
5/3/2022: hold safe instrument	

Navigation: [Back] [Forward] [Home] [End] | Edit | Run-time | **Trace**

To see this output, perform the following steps:

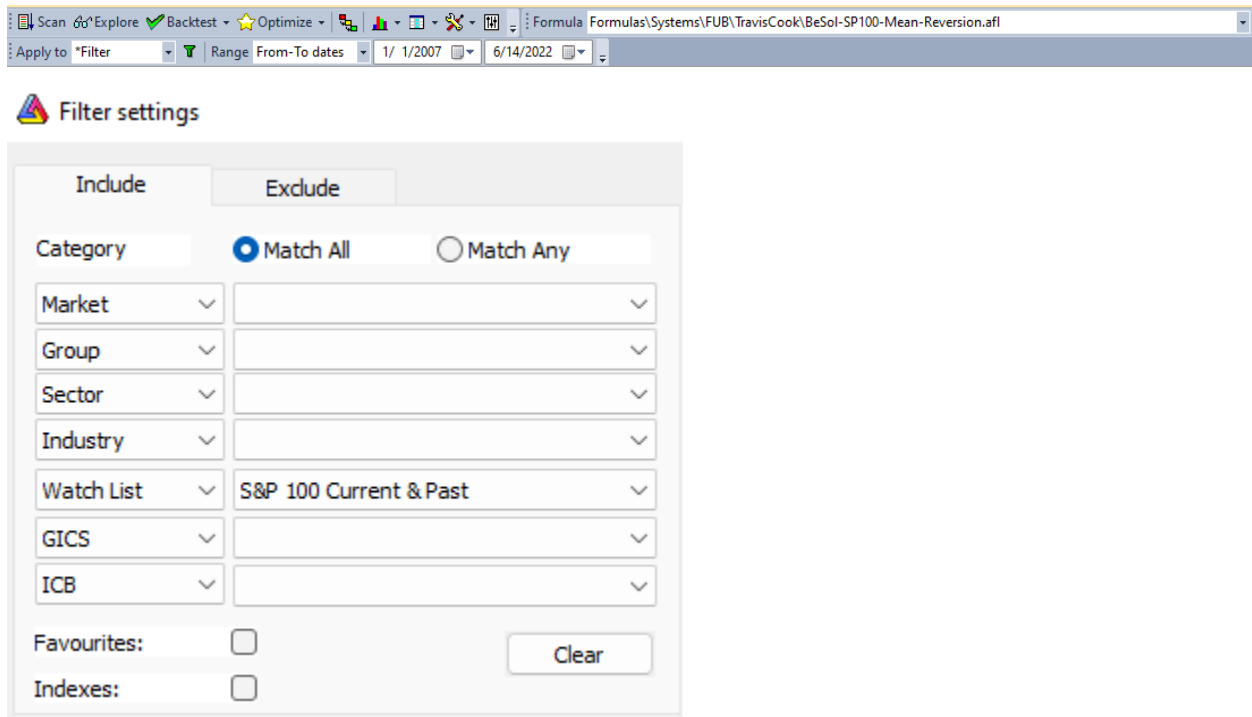
- Open the log window
- Select the trace tab
- Right-click the content pane and internal for the trace output

## Installation

We provide the strategy as an APX archive, containing all required parameters. To import the strategy, perform the following steps:

- Copy the APX file to a convenient location
- Open the APX file from the file-open menu
- Double-check that the strategy applies to a filter, and that the filter uses the S&P-100 Current and Past watchlist.
- Double-check that the start date is 01/01/2007, and the end-date is current.

Here are screenshots of all settings we used to run the strategy:





Analysis settings ✕

General Trades Stops Report Portfolio Walk-Forward Monte Carlo

**Data**

Periodicity:   Use QuickAFL

Pad and align all data to reference symbol:   
 (turning this on may slightly change indicators if you have data holes)

**Backtest**

Initial equity:   Allow position size shrinking

Positions:   Allow same bar exit / entry signal

Min. shares:   Reverse entry signal forces exit

Min. pos. value:   Futures mode

Max. pos. value:  (zero means no maximum)

Round lot size:  (zero means allow fractional # of shares)

Tick size:  (zero means no minimum change)

**Commissions & rates**

commission table  Fixed annual interest [%]:

percent Dynamic interest symbol:

\$ per trade  Margin rate [%]:

\$ per share/contract Account margin:   
 (100 means no margin account)

Analysis settings ✕

General Trades Stops Report Portfolio Walk-Forward Monte Carlo

Scenario:

**Long trades**

Buy price:  Sell price:

Buy delay:  Sell delay:

**Short trades**

Short price:  Cover price:

Short delay:  Cover delay:

Analysis settings ✕

General Trades **Stops** Report Portfolio Walk-Forward Monte Carlo

Scenario: Trade NEXT BAR on OPEN, the stops exit on NEXT BAR OPEN ▾

Activate stops immediately (trigger stops AFTER regular signals)

**Maximum loss stop**

disabled Exit next bar at trade price (2) ▾

percent loss:  Re-entry delay:

point

**Profit target**

disabled Exit next bar at trade price (2) ▾

percent profit:  Re-entry delay:

point

**Trailing stop**

disabled Exit next bar at trade price (2) ▾

percent risk:  Re-entry delay:

point

percent of profit

**N-bar stop**

disabled Has priority

bars bars:  Re-entry delay:

## Analysis settings



General Trades Stops **Report** Portfolio Walk-Forward Monte Carlo

Reporting

Result list shows:  Trade list  
 Detailed log  
 Summary

Risk-free rate for Sharpe ratio:  UPI:

Distribution charts spacing (%)

Enable user-definable charts in the reports

MAE/MFE distribution charts (Professional Edition only)

Chart dimensions (in pixels):  
width:  height:

Generate detailed reports for each symbol in individual backtest (slow)

Include trade list in the report

Include formula in the report

Include Buy-and-Hold stats Portfolio B&H symbol:

Warn before running time-consuming optimizations

## Analysis settings



General Trades Stops Report **Portfolio** Walk-Forward Monte Carlo

Portfolio-level settings

Max. Open Positions:

Add artificial future bar (allows to see tomorrows trade picks)

Limit trade size as % of entry bar volume:  
(zero means no-limit)

Disable trade size limit when bar volume is zero  
(allows to backtest mutual funds that come without volume data)

Use previous bar equity for position sizing

Enable custom backtest procedure

Custom backtest procedure path:

Analysis settings ×

General Trades Stops Report Portfolio Walk-Forward **Monte Carlo**

Enable Monte Carlo simulation

Number of runs:

Simulate using portfolio equity changes

Simulate using trade list

Position sizing:  Don't change

Fixed size  shares/contracts

Constant Value

Percent of Equity

Enable MC Equity curves (Min/Max/Avg)

Show Absolute values in linear scale

Show Absolute values in logarithmic scale

Show Percent change

Straw broom chart plots:

Use logarithmic scale for Final equity

Use logarithmic scale for \$ Drawdown

Use negative numbers for Drawdown (reverse Drawdown CDF)