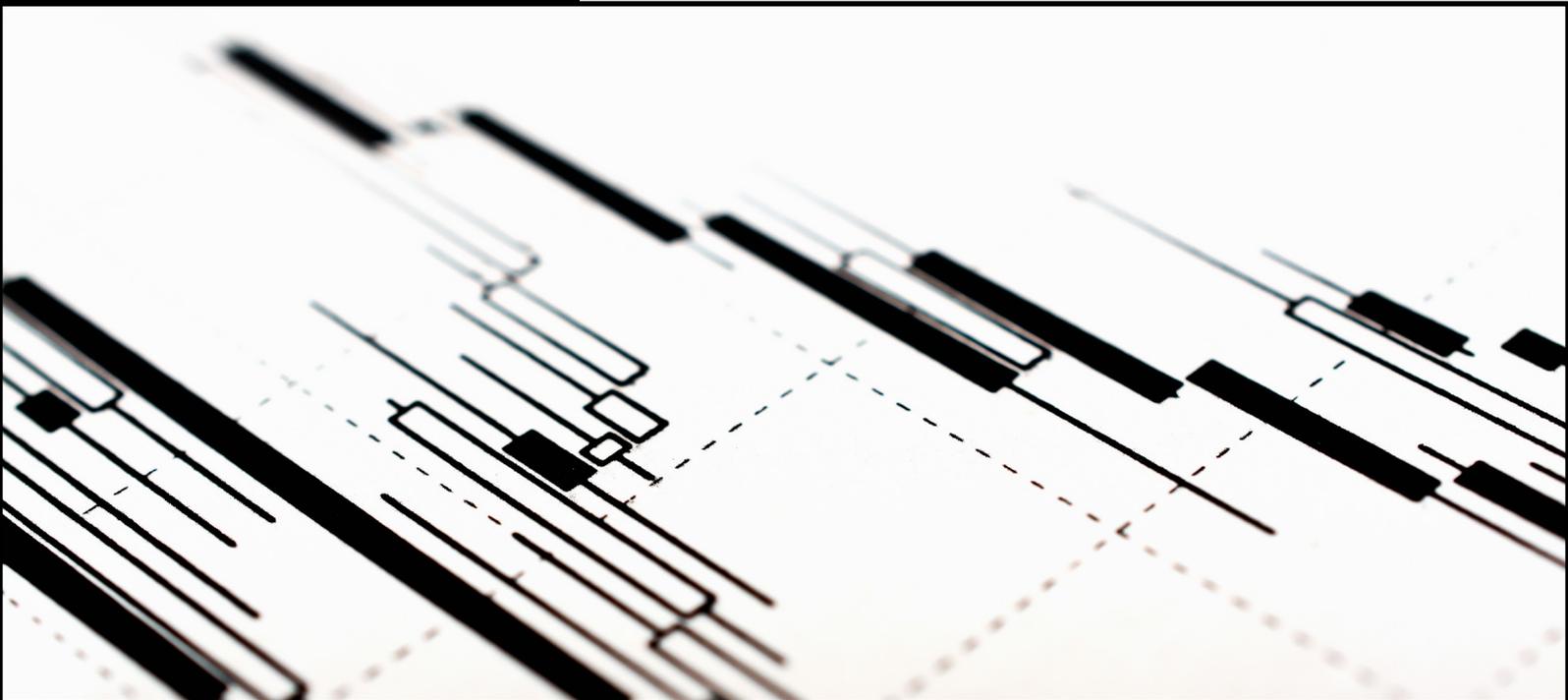


JANUARY 2015



# UNUSUAL VOLUME SYSTEM

A short term trading strategy for stocks  
based on unusual changes in volume.

WHITE PAPER

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# UNUSUAL VOLUME SYSTEM

## INTRODUCTION

Volume can best be described as the number of shares that change hands during a given day. It is therefore a useful indicator for measuring investor appetite and market behaviour.

In the context of a single stock trading on a stock exchange, volume can even be used to explain momentum and directional changes. And generally, when a stock moves on heavy volume, that movement is considered more important than if it were to happen on light volume.

Typically, traders use volume to help confirm price moves and make trades in the same direction as the herd. And volume will often peak when a big market move takes place.

The reason for this is because when a big market event takes place, such as a company reporting earnings, many traders will come together to buy or sell the stock; based on the latest information. If a large number of traders come together at the same time and they all take a similar position, that might be construed as a significant clue into the future direction of the stock.

The rest of this paper will look at a trading strategy that attempts to profit from unusual changes in a stock's recent volume.

## Recent research

Traders have been interested in the effect of volume in the stock market for a long time and there are no shortage of research papers looking into this relationship.

One paper that caught my interest was The Information Content of Abnormal Trading Volume by Bajo.<sup>1</sup>

<sup>1</sup> Bajo, Emanuele, The Information Content of Abnormal Trading Volume (2009-10). Journal of Business Finance & Accounting, Vol. 37, Issue 7-8, pp. 950-978, July/August 2010. Available at SSRN: <http://ssrn.com/abstract=1677707>

This paper looks into the Milan Stock Exchange in order to see whether there is any relationship between short-term stock returns and unusual changes in volume.

The approach used was to consider volume as being "unusual" if the daily trading volume was more than 2.33 standard deviations away from the mean. The strategy then buys those stocks with unusual volume – which had also finished with a daily gain of 1% – and holds them for one day.

## Initial findings & Modifications

I found some interesting insights from reading this paper so decided to test the strategy further using the back-testing platform Amibroker.

Overall, I found that the unusual volume 'trigger' worked well for selecting shares on the move. I decided to make some modifications to the initial strategy presented in order to try and improve returns and make the strategy more applicable to the US stock market.

I decided to increase the timeframe of the trading system to weekly and make the unusual volume trigger slightly more restrictive. I did this by increasing the standard deviation measure to 3 instead of 2.33.

The following tests show the full rules and back-test results for the modified unusual volume strategy. I then briefly talk about some of the difficulties of this strategy and some possible areas of improvement.

## TEST ONE

For the first test, I loaded up data for all stocks in the S&P 1500 universe in Amibroker. This database includes data for all current and historical constituents of the index and is provided by Norgate Premium Data.

I then instructed the platform to follow the following strategy rules:

### Strategy rules:

**First, the platform calculates the average volume over the last 50 weeks for each stock in the universe.**

**When a stock's volume is 3 standard deviations above its 50 week mean, buy the stock on the close.**

**• So long as the close is above the open, the average volume is above 100,000 shares and the volume trigger has not occurred before in the last 33 weeks. The stock must also have opened above 1 – this is to avoid illiquid penny shares.**

**Sell the stock on the next weekly close.**

## Settings:

The following settings were used in Amibroker to further control the strategy:

Portfolio size was set at 1, meaning only one stock could be held at a time. Margin was set at 100 so trades were made with cash and no leverage was used.

Position size was set at 100% of capital available and starting capital was left at \$10,000. Thus, a stock priced at \$20 resulted in a purchase of 500 shares (\$10,000 / \$20).

Commissions were set at \$0.01 per share to cover fees and slippage, in line with Interactive Brokers and standard slippage measures.

## Strategy in plain language

In other words, this trading strategy looks to buy stocks that have experienced unusual volume and holds them for one week (five working days).

Whenever a stock's volume is 3 standard deviations above it's 50 week average, the stock is bought on the close.

The stock must also be above \$1 and close higher than it opened. As well, the same volume signal must not have occurred any time before in the last 33 weeks.

So, if the stock's volume broke 3 standard deviations a couple of weeks ago as well, the signal is ignored.

An example trading signal for the strategy can be seen in the following weekly price chart for \$AAP (Advanced Auto Parts Inc.):



The top panel shows the stock price while the bottom panel shows the weekly

volume with the Bollinger Band indicator overlaid. The top Bollinger Band has been set 3 standard deviations away from the 50 week mean. (The Bollinger Band is thus a simple way to check when the unusual volume signal has occurred).

As the chart shows, volume for \$AAP broke the 3 standard deviation line on the 18th October 2013.

As well, this event had not occurred before in the last 33 weeks and the open price was above \$1. The average volume was well above 100,000 shares and lastly, the close price was greater than the open price.

A buy signal (green arrow) was therefore initiated on the close at a price of \$98.47 and the trade was then closed on next week's close, at a price of \$102.43.

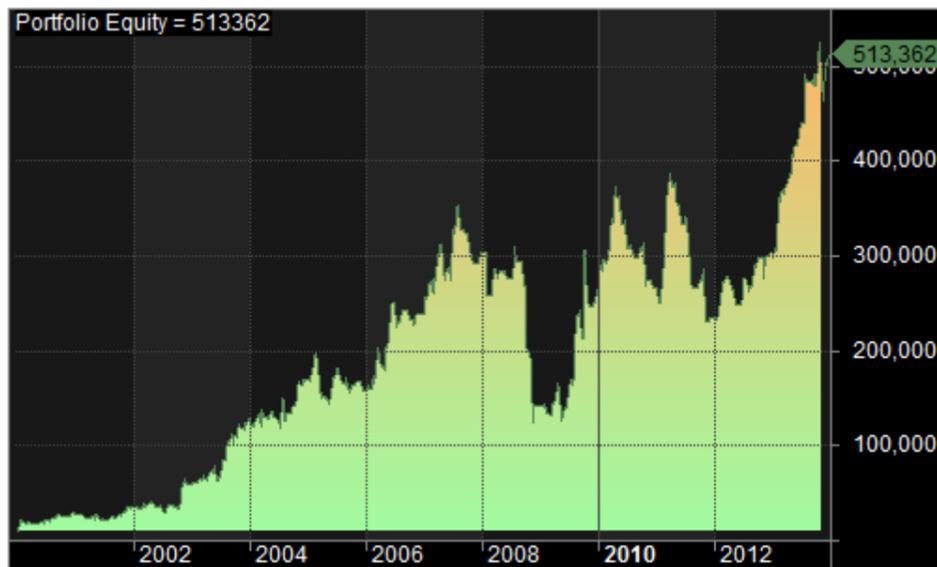
This resulted in a percentage change of 4.02% and a profit of 4% after commission and slippage was applied.

## Results:

Running this system on all stocks in the S&P 1500 universe between 1/1/2000 and 1/1/2014 produced the following results:

[Statistics](#) | [Charts](#) | [Trades](#) | [Formula](#) | [Settings](#) | [Symbols](#)

	All trades	Long trades	Short trades
Initial capital	10000.00	10000.00	10000.00
Ending capital	513362.23	513362.23	10000.00
Net Profit	503362.23	503362.23	0.00
Net Profit %	5033.62 %	5033.62 %	0.00 %
Exposure %	60.94 %	60.94 %	0.00 %
Net Risk Adjusted Return %	8260.49 %	8260.49 %	N/A
Annual Return %	32.54 %	32.54 %	0.00 %
Risk Adjusted Return %	53.40 %	53.40 %	N/A
Total transaction costs	115464.74	115464.74	0.00
Max. trade drawdown	-62842.50	-62842.50	0.00
Max. trade % drawdown	-25.76 %	-25.76 %	0.00 %
Max. system drawdown	-229058.17	-229058.17	0.00
Max. system % drawdown	-64.76 %	-64.76 %	0.00 %
Recovery Factor	2.20	2.20	N/A
CAR/MaxDD	0.50	0.50	N/A
RAR/MaxDD	0.82	0.82	N/A
Profit Factor	1.35	1.35	N/A
Payoff Ratio	1.12	1.12	N/A
Standard Error	54373.81	54373.81	0.00
Risk-Reward Ratio	0.51	0.51	N/A
Ulcer Index	21.51	21.51	0.00
Ulcer Performance Index	1.26	1.26	N/A
Sharpe Ratio of trades	0.62	0.62	0.00
K-Ratio	0.0756	0.0756	N/A



Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr%
2000	101.4%	11.0%	-1.0%	0.1%	4.4%	11.1%	3.9%	11.2%	8.8%	-3.2%	4.3%	6.2%	177.9%
2001	-0.7%	-10.7%	-2.6%	11.8%	-7.3%	-11.1%	-3.8%	11.9%	15.3%	6.7%	20.9%	-0.7%	26.6%
2002	-1.7%	-0.8%	8.1%	10.8%	-12.6%	-7.9%	-13.9%	28.0%	-6.0%	12.6%	56.6%	-1.8%	68.9%
2003	1.3%	6.2%	2.5%	7.1%	13.4%	-17.0%	27.6%	23.2%	6.9%	9.6%	-3.8%	9.7%	116.1%
2004	-4.2%	8.4%	-0.2%	-3.1%	0.7%	-2.2%	16.0%	-8.7%	2.9%	17.5%	1.1%	3.0%	31.9%
2005	6.1%	9.7%	-21.3%	-3.1%	0.0%	17.0%	-5.9%	-0.8%	-2.7%	3.3%	1.6%	-5.9%	-7.0%
2006	1.4%	3.8%	15.3%	-6.5%	19.2%	17.7%	-7.9%	5.1%	-4.2%	-2.0%	5.4%	-0.4%	51.7%
2007	9.1%	0.5%	15.1%	-1.5%	-3.3%	14.3%	6.9%	-6.7%	-0.9%	-7.3%	-3.0%	4.0%	27.0%
2008	-0.1%	14.8%	10.4%	-0.3%	0.0%	-2.9%	11.9%	-4.6%	-8.9%	-30.7%	24.2%	N/A	-53.5%
2009	2.3%	-7.8%	8.7%	8.9%	-14.6%	19.4%	8.6%	35.9%	-10.3%	19.1%	-2.7%	7.2%	87.4%
2010	11.9%	0.1%	14.3%	6.9%	-7.8%	-7.7%	-1.7%	-1.5%	2.9%	-10.7%	-0.0%	-3.0%	0.6%
2011	-2.0%	37.4%	8.2%	-2.8%	-6.5%	-5.4%	-13.7%	-7.0%	2.7%	3.9%	-18.9%	1.1%	-12.0%
2012	1.8%	14.6%	1.7%	-4.4%	-5.9%	10.5%	-4.4%	2.0%	10.7%	0.2%	0.5%	1.0%	29.4%
2013	1.3%	19.6%	1.4%	3.7%	8.2%	5.3%	11.8%	-1.7%	-0.5%	8.7%	-3.8%	2.1%	69.5%
Avg	9.1%	4.0%	4.3%	2.0%	-0.9%	2.9%	2.5%	6.2%	1.2%	2.0%	2.4%	1.6%	

As you can tell from the table of results, CAR (compounded annual return) for this system was 32.54% and the maximum system drawdown was -65%.

The risk adjusted return was 53.40% and the system managed to turn \$10,000 into \$513,362 in the space of 14 years.

Recovery factor was 2.20 and the Sharpe ratio was an adequate 0.62.

This is a decent set of results for test one.

## TEST TWO

The results of this first test are promising, particularly in terms of compound annual return and Sharpe ratio.

If there is a downside to this strategy it is with the fairly large drawdown.

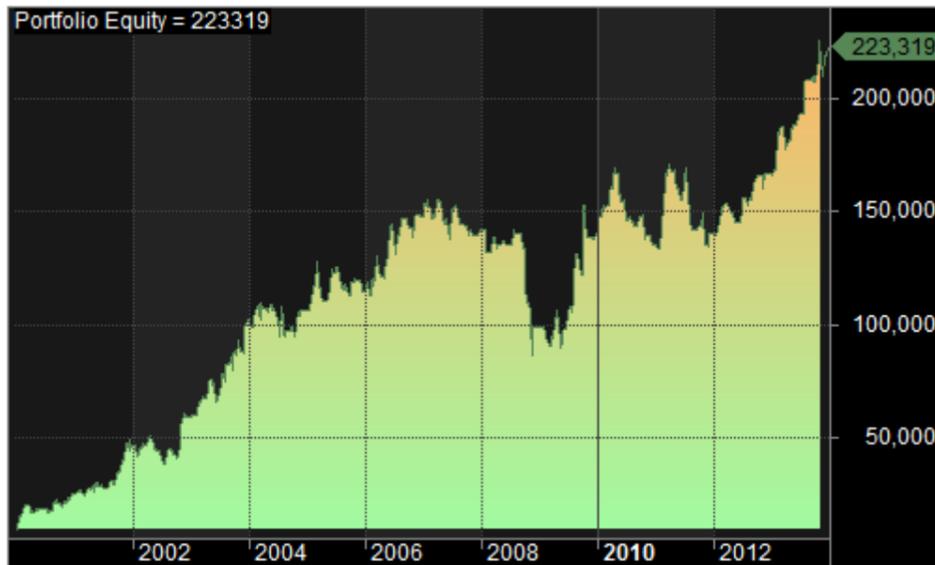
Therefore, in this test I attempt to improve on the drawdown by incorporating a bigger portfolio size and limiting risk.

I do this simply: by halving position size and doubling the maximum number of portfolio positions to two.

As you can see from the following results, diversifying the portfolio in this way helped to reduce drawdowns but also harmed the compound annual return of the strategy.

## Results

	Statistics		
	All trades	Long trades	Short trades
Initial capital	10000.00	10000.00	10000.00
Ending capital	223319.07	223319.07	10000.00
Net Profit	213319.07	213319.07	0.00
Net Profit %	2133.19 %	2133.19 %	0.00 %
Exposure %	48.46 %	48.46 %	0.00 %
Net Risk Adjusted Return %	4401.58 %	4401.58 %	N/A
Annual Return %	24.88 %	24.88 %	0.00 %
Risk Adjusted Return %	51.33 %	51.33 %	N/A
Total transaction costs	55839.22	55839.22	0.00
Max. trade drawdown	-15603.56	-15603.56	0.00
Max. trade % drawdown	-25.76 %	-25.76 %	0.00 %
Max. system drawdown	-67959.85	-67959.85	0.00
Max. system % drawdown	-43.82 %	-43.82 %	0.00 %
Recovery Factor	3.14	3.14	N/A
CAR/MaxDD	0.57	0.57	N/A
RAR/MaxDD	1.17	1.17	N/A
Profit Factor	1.33	1.33	N/A
Payoff Ratio	1.18	1.18	N/A
Standard Error	21085.94	21085.94	0.00
Risk-Reward Ratio	0.54	0.54	N/A
Ulcer Index	12.33	12.33	0.00
Ulcer Performance Index	1.58	1.58	N/A
Sharpe Ratio of trades	0.54	0.54	0.00
K-Ratio	0.0809	0.0809	N/A



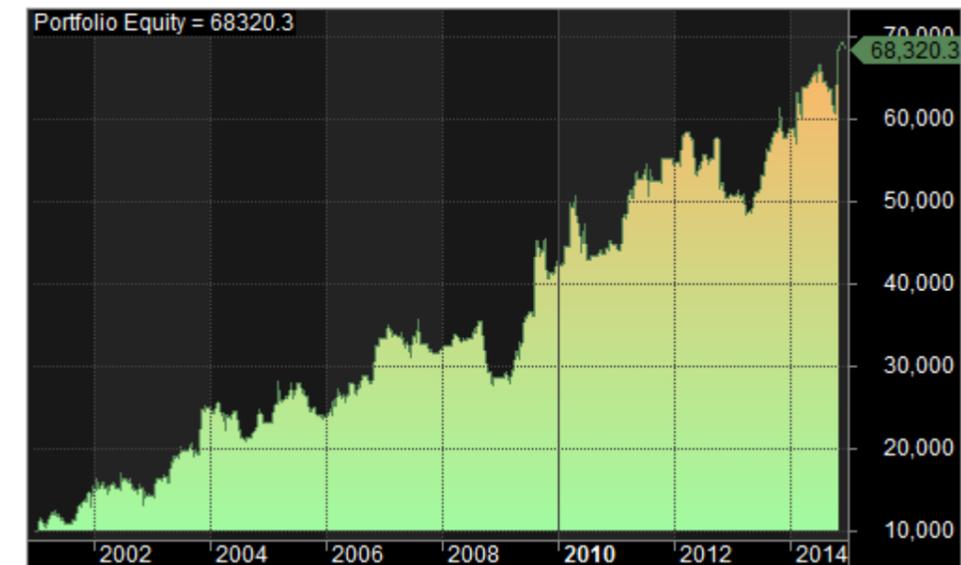
Max. trade drawdown	-6094.13	-6094.13	0.00
Max. trade % drawdown	-26.70 %	-26.70 %	0.00 %
Max. system drawdown	-10045.08	-10045.08	0.00
Max. system % drawdown	-22.97 %	-22.97 %	0.00 %
Recovery Factor	5.81	5.81	N/A
CAR/MaxDD	0.64	0.64	N/A
RAR/MaxDD	1.63	1.63	N/A
Profit Factor	1.38	1.38	N/A
Payoff Ratio	1.23	1.23	N/A
Standard Error	3648.62	3648.62	0.00
Risk-Reward Ratio	1.05	1.05	N/A
Ulcer Index	8.39	8.39	0.00
Ulcer Performance Index	1.11	1.11	N/A
Sharpe Ratio of trades	0.45	0.45	0.00
K-Ratio	0.1569	0.1569	N/A

### TEST THREE

In this next test I change the data sample and decide to test the strategy on stocks from the Russell 1000 universe, including current and historical constituents. I move the dates forward a year and test 1/1/2001 - 1/1/2015.

I do this in order to test the robustness of the results. If the strategy performs well on different data sets and on different dates (particularly out-of-sample) I regard it as a good sign that the system is strong.

Note: There are many more ways to validate a trading system which can and should be undertaken before taking the system live. They include extensive out-of-sample and cross-validation testing, monte-carlo analysis and finally, paper trading the system in current conditions.



### Results

	All trades	Long trades	Short trades
Initial capital	10000.00	10000.00	10000.00
Ending capital	68320.25	68320.25	10000.00
Net Profit	58320.25	58320.25	0.00
Net Profit %	583.20 %	583.20 %	0.00 %
Exposure %	39.35 %	39.35 %	0.00 %
Net Risk Adjusted Return %	1482.06 %	1482.06 %	N/A
Annual Return %	14.73 %	14.73 %	0.00 %
Risk Adjusted Return %	37.44 %	37.44 %	N/A
Total transaction costs	14457.38	14457.38	0.00

As you can see from the results of test three, the strategy put in a reasonable performance when back-testing on the Russell 1000 universe of stocks but performance was not as strong as testing on the S&P 1500 universe.

CAR dropped to 14.73%, though the maximum system drawdown was much more healthy at -23%.

Overall, the results are encouraging, and the equity curve is an attractive one.

Following on the next page is another trade example, this time taken from test three:



As you can see, the strategy gave a profitable signal for \$BWA (BorgWarner Inc.) on the week of 29 October 2004.

Weekly volume spiked above the 3 standard deviation line leading to a profitable trade of 6.72%.

### ASSUMPTIONS

Now we have seen some of the back-test results, it should be noted that the unusual volume strategy relies on some key assumptions that may make these results slightly less accurate than shown.

Most importantly, the strategy involves trading right on the close, which is theoretically impossible, since when a market is closed trades cannot be placed.

Furthermore, the strategy relies on standard deviation calculations which are also made using close prices that are unknown.

However, traders should be able to make a judgement call here and make trades very near to the close if it is clear that all the rules will be satisfied.

For example, if the time is one minute to the close and volume is much more than three standard deviations away, and the stock is clearly going to close higher than it opened, there should not be too much of a problem for a trader to take on the trade.

In reality, traders may even be able to improve the strategy by fine tuning their entries and exits.

### The problem of bid/ask price data

While the problem of trading on the close may not be too difficult to overcome there is another difficulty with this type of system and that is due to the nature of bid/ask quotes on historical price data.

When historical EOD (end-of-day) data shows a price quote, it only shows the highest and lowest price that the market actually traded at on that day.

When you are live trading, you may not have been able to get filled at that best price, and you may well have had to pay a worse price than shown on the chart.

This is a common problem for trading system developers and is the reason why traders put a lot of time into verifying results and testing different levels of slippage.

### IMPROVEMENTS/CONSIDERATIONS

Overall, the strategy presented here looks to have some merit but there may well be ways to improve on it further and I have left out some options that could be worth consideration.

First, each test was run with no consideration to signal ranking.

In other words, when the system encountered more than one trading signal, it used the default Amibroker RSI setting to choose which signal to take. (Stocks with lower RSI readings were favoured).

Duplicate signals do occur fairly regularly with this system, so a better approach to ranking might yield slightly better results.

Secondly, I have done very little testing on holding periods and it may well be that longer holding periods (ie. longer than a week) could result in stronger performance.

Holding trades a little longer, from 6 to 20 weeks perhaps, could well provide some interesting results.

Doing so might make it easier to test a larger portfolio size too, such as a portfolio of 20 simultaneous positions. And this could lead to some alterations to the risk settings used.

### UNUSUAL VOLUME FORMULA

To calculate the unusual volume trigger, it is simple enough to use the top Bollinger Band indicator to measure the standard deviation threshold. In Amibroker, the following code can be applied:

```
Stdvol = BBandTop(V,50,3);
Unusualvolume = Cross(V, Stdvol);
Buy = Unusualvolume;
```

Thus, when volume crosses over the standard deviation line, the unusualvolume function is triggered. Other criteria, such as the close price being greater than the open price, can then be added as per the strategy rules.

The unusual volume strategy can then be applied on a weekly basis to US stocks. Although some more testing may need to be done, the strategy shows some merit. It may also work just as well on other local stock markets.

**Credits:**

Bajo, Emanuele, The Information Content of Abnormal Trading Volume (2009-10). Journal of Business Finance & Accounting, Vol. 37, Issue 7-8, pp. 950-978, July/August 2010. Available at SSRN: <http://ssrn.com/abstract=1677707>

Amibroker

Norgate Premium Data