Pairs Trading: A new approach

FRÉDÉRIC DÉLÈZE (*Hanken School of Economics, Finland, frederik.deleze@hanken.fi)*

With the decline of transaction costs, the advances of technology and the improvement of market liquidity, high-frequency auto-trading has attracted rapidly growing interest in recent years. The development of automated trading system is also supported by the replacement of physical open outcry market with fully electronic exchanges, such as NASDAQ. One of the most popular and successful automated trading algorithm is called pairs trading. It consists of trading correlated pairs of books by taking long or short positions in one of the book pair as soon as pairs diverge abnormally. Originally introduced in 1986 by Nunzio Tartaglia, head of the Analytical Proprietary Trading group at Morgan Stanley, the strategy formerly applied on daily stock prices is still the cornerstone of statistical arbitrage strategies, but mainly run with futures using real time tick-by-tick trade and quote data.

This article proposes a general pairs trading algorithm for both daily and intraday data. Given two highly correlated traded assets, as index futures, a pairs trading or market neutral strategy takes a long position in one of the securities and a short position in other security as soon as the spread between the returns widens abnormally. Should the spread eventually converge to its long-term value, and then the reverse position is taken. While in the short run the distance, or spread, between the two normalized prices sequences might fluctuate randomly up and down, in the long run it ought to be drawn back towards its long-term equilibrium. Thus, it can be modelled as a discrete mean-reverting process.

The first part of the article shows how the price differences or spread between a trading pair can be modelled with a discrete or continuous Ornstein-Uhlenbeck or Cox-Ingersoll-Ross model and describes the pairs trading algorithm. In the second part of the document I propose a new calibration method to profit of changes in correlation between the two normalized time series. The key feature of pairs trading is to find an optimal barrier level, which maximizes the profit at the end of the trading period. The number of trades generated by the algorithm depends on the barrier level. A low-level barrier will generate many trades, a high amount of fees and increases the probability of non-executed orders placed in the market. On the contrary, an abnormally high barrier level will barely generate any trade. To be robust over time, the average number of trades per period should not fluctuate too much, whenever the market is volatile or illiquid. Unlike traditional pairs trading algorithms, the trigger level is not kept fixed at two standard deviations above the long-term mean of the spread, but varies according to the market activity. The constraints on the number of trades per period are obtained by optimising the barrier level such that the mean and variance of the first-passage time of the spread process is bounded. Finally, the behaviour of the algorithm is illustrated with various pairs of European index futures.