The reality of financial markets

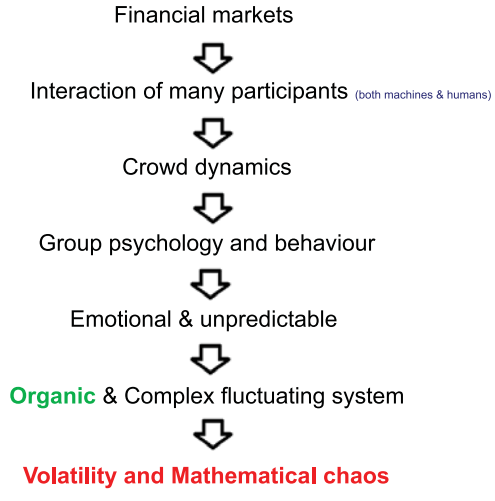
(a stochastic process of triangles, fractals and chaos)

By Simon Maelzer

The journey of a financial market analyst, and especially that of a technician, is a long one that often involves a great deal of trial and error. Most technicians at some point will find themselves in a situation where they have many indicators filling their chart space. This often results in a state of confusion and contradiction, with the analyst left scratching their head as they try to work out the market. Additionally, we seek out information and education in a variety of places, whether it be in printed format, the internet or in person. With my own learning experience, I often felt that the true nature of the financial markets was not really discussed. So in this article, I hope to take the reader back to basics and develop a method of analysis from first principles.

In the context of this article, I shall define a financial market as instruments and assets that are traded on an open and regulated market place/exchange, be it open outcry or electronic (or a mixture of the two). Markets exist for a variety of reasons, such as to take ownership of an asset, hedge risk or speculate for profit. Markets generally have many participants (both human and progressively more electronic machines) which means many opinions. It is these differences in opinion on pricing and what something is worth that creates a fluctuating price as everyone competes to gain an edge. Price can do one of only three things; go up, go down, go sideways. Price rarely stays static as the urge to profit, hedge risk or take ownership is always apparent and thus a constant price discovery process occurs. In the financial market environment, value is certainly a fickle dynamic.

Figure 1: Model of the market environment



CHAOS

Yes, financial markets are mathematical chaos. Although we often here the term 'chaos' on the news wires and media, what is the definition according to The Oxford English Dictionary? ' The property of a complex system whose behaviour is so unpredictable as to appear random, owing to great sensitivity to small changes in conditions'.

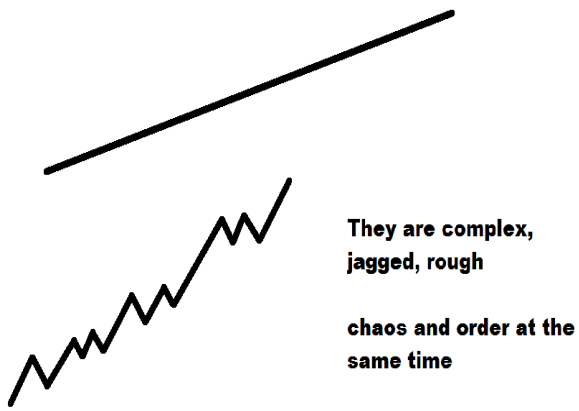
Additionally, chaotic financial markets result in a system with the following characteristics:

Non Linear (not arranged in a straight line, not sequential or straightforward);

Stochastic (having a random probability distribution or pattern that may be analysed statistically but may not be predicted precisely);

Fractal (a curve or geometrical figure, each part of which has the same statistical character as the whole, in which similar patterns recur at progressively smaller scales, and in describing partly random or chaotic phenomena such as crystal growth and galaxy formation).
Definition source: The Oxford English Dictionary

Figure 2: Non linearity



It is not just financial market time series data that have these characteristics. Many processes in the world are stochastic processes that produce very similar data outputs. If you viewed much of this data without knowing what it was and with no values on the graph, you could not tell if it was river discharge data, wave buoy data, wind speed data, temperature, a sport team's league position or your favourite stock. (Figure 3)

Even a simple coin flipping experiment (where you start the time series at 0 and add one to the aggregate count for a head and subtract one for a tails) will produce very similar data. Benoit B. Mandlebrot discusses this in excellent book *The (Mis) Behaviour of markets.* In the long run (the law of large numbers) the count should always revert to the expected value of zero, but just like markets, the coin can stay irrational for extended periods of time and trends and continuation patterns can and do prevail for long periods. (Figure 4)

These types of stochastic processes, where constant adding and subtracting to the aggregate occurs, produce a time series with an

Figure 3: A world full of stochastic processes.

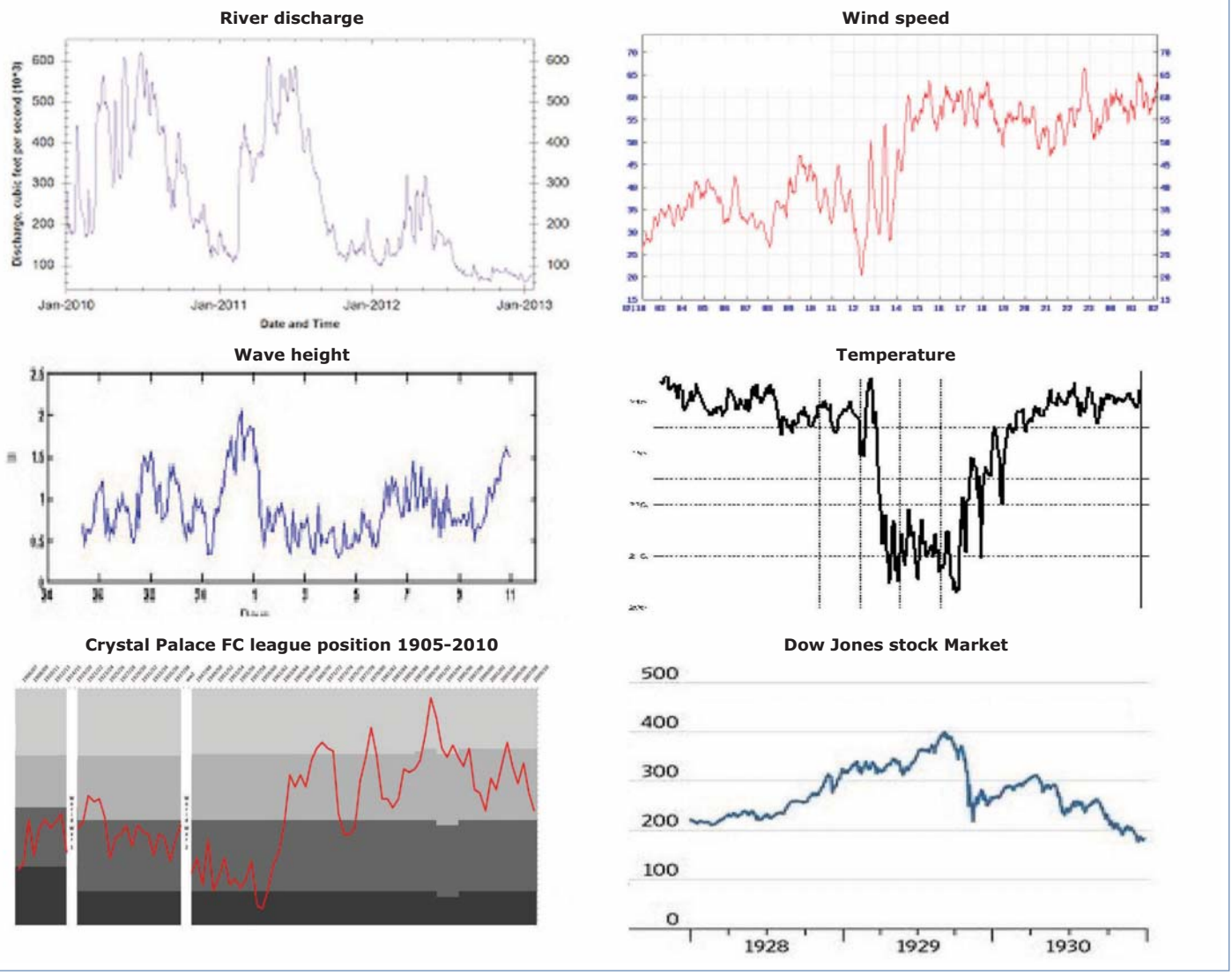
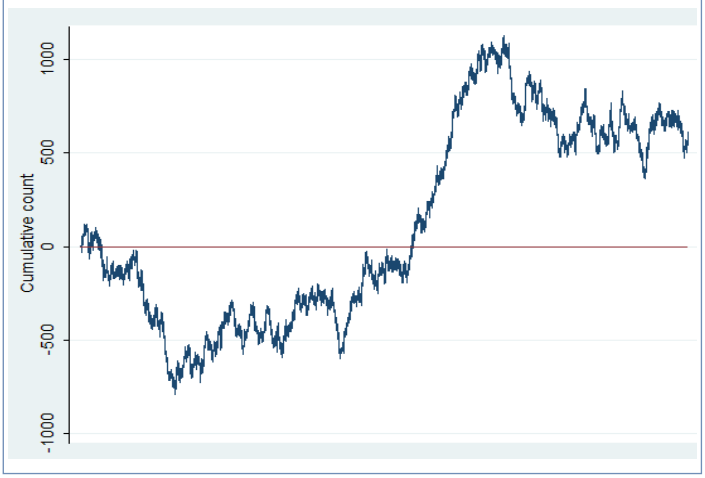


Figure 4: A millions coin tosses

Coin flipping experiment results (1 million coin flips)
Source: http://www.smbtraining.com/



evolving high-low-high-low structure as seen in Figure 5. This process creates triangulation (formation of or division into triangles) at all scales, that all link up to form the whole. Essentially, financial market data is scale invariant, producing repetitive, the same or very similar geometric shapes and patterns, whatever the scale, as can be seen in Figures 6 and 8. Where Euclidean geometry failed to explain these natural phenomenons, Mandelbrot stepped in and invented the term 'Fractal' to describe such rough and jagged behaviour.

Figure 5

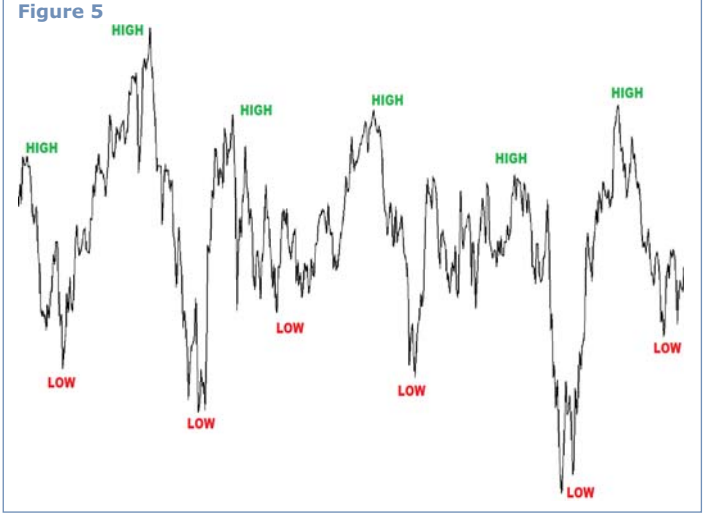


Figure 6

Figure 7: Markets evolve with a constant up/down or progress/regress structure resulting in fractal triangulation.

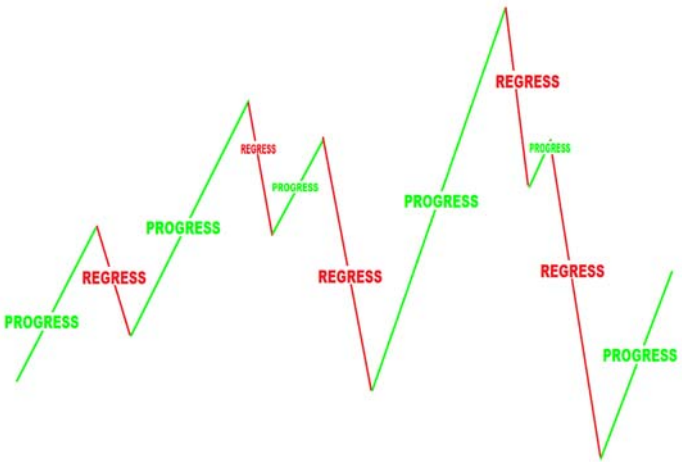
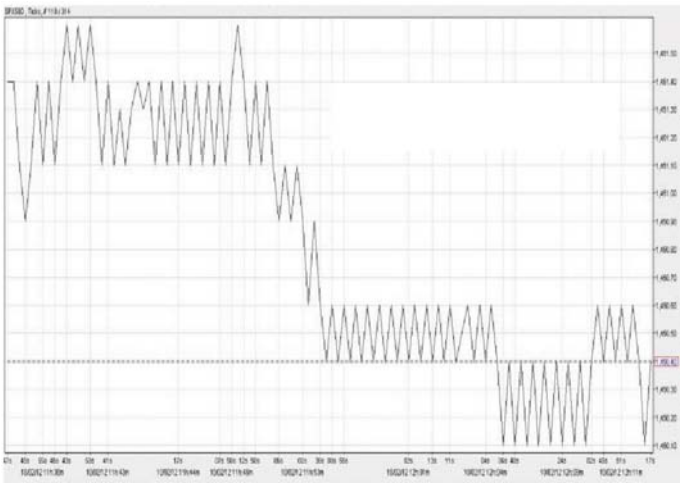


Figure 8: Examples of triangulation

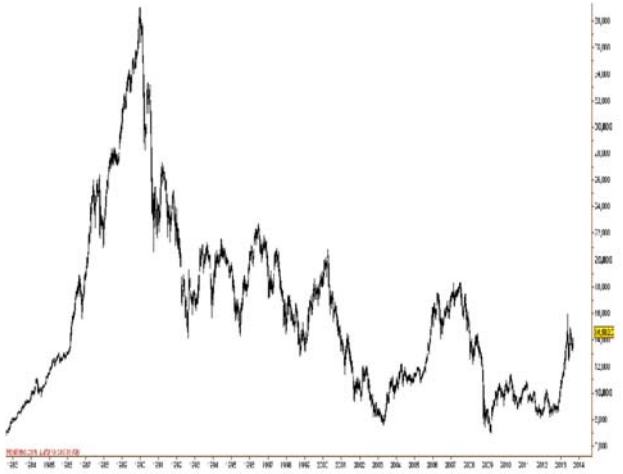
S&P 500 Futures tick data covering a couple of seconds



1 minute Dax future data

Crude oil hourly futures data

Weekly macro data (multi-decade) Nikkei 225



So how can we analyse this data for investment or trading purposes?

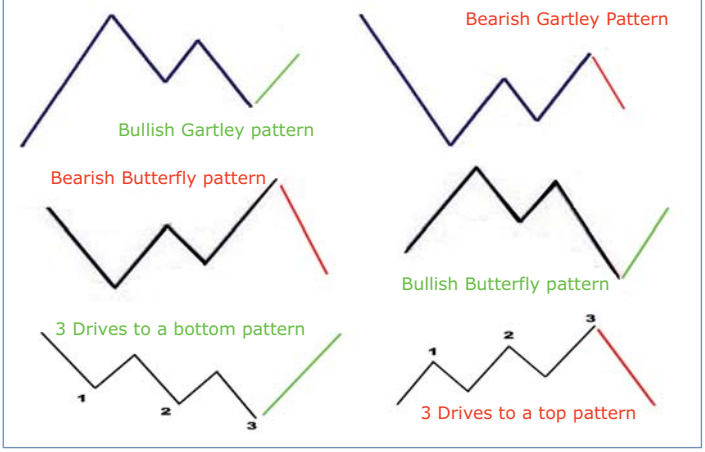
As mentioned, financial time series do produce repetitive-self similar patterns which is often at the heart of technical analysis and being able to identify the so-called patterns. However, it is important to remember that stochastic processes are largely unpredictable. This I believe is one of the main reasons the art of technical analysis is held in disregard by much of academia and Wall Street.

However, all is not lost, there are tools and techniques at hand that enable us to build models for analytical inference, that can then be used for the trading/investment process. Furthermore, as many financial instruments are leading indicators of the various subsets of the economy, major insights into the overall economy can be garnered.

The three techniques I will touch upon are pattern recognition, ratio analysis and volatility bands with Heiken-Ashi bars.

Pattern recognition is similar in essence to traditional technical analysis patterns. They just have different names like Butterfly, Gartley and Three Peaks (see Figure 9) and are based on high-low-high triangulation structures. I highly recommend studying the work of Larry Pesavento who is a pioneer on the subject.

Figure 9: The three main patterns

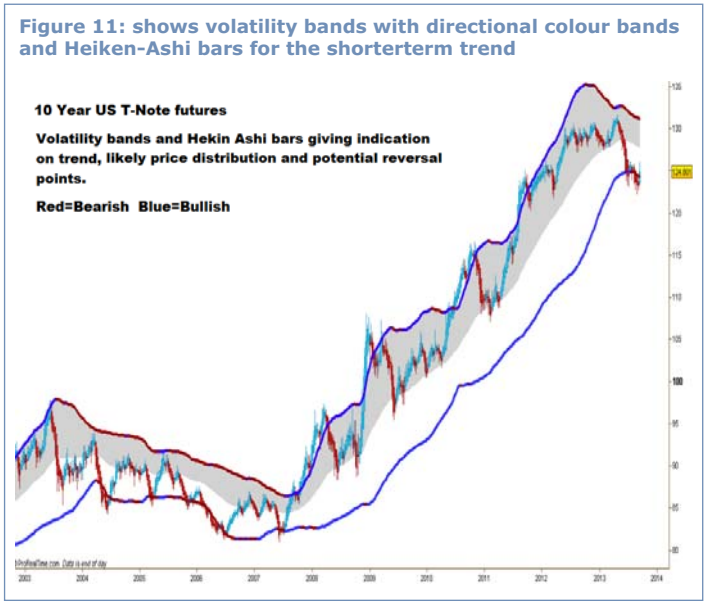


With these patterns, one can also incorporate ratio analysis (see chart 10). Basically, you measure in percentage terms the retracements and expansions of price. This technique can also be applied to any high-low-high triangle that appears every minute, hour, day, week, month and year in all financial markets. When two or more key percentage ratios (38%, 50%, 61.8%, 78.6%, 88%, 100%, 127.2%, 161.8%, 200% 261.8%) cluster, powerful trading signals can arise. The ratios come from wholes, halves and Fibonacci numbers and their inverse square and square roots. For example 127.2% is the square-root of Fibonacci's famous 161.8%. Note: the ratios do not have to cluster at exactly the same price level, essentially we are looking for zones or regions within a 0-1% window of price.

Figure 10: Macro example of pattern recognition with % ratio technique

Volatility bands or Bollinger bands are also a very useful tool as they give some statistical reasoning to the research process. Although one could argue there is an arbitrary nature to using such applications, as one can can select any random number for both the sampling period and the standard deviation, and additionally one can smooth the data with simple, weighted or exponential moving averages. However, I firmly believe there is scope to find settings that work well across most data. Of course this technique is by no means a complete solution to market analysis, but they can aid the analyst with likely probability distributions for future price and trend information for both the longer and shorter term.

Figure 11: shows volatility bands with directional colour bands and Heiken-Ashi bars for the shorterterm trend



This article has only touched on a few, but if you feel this area of analytics makes sense, I urge the reader to explore the works of both Mandelbrot and Pesavento.

I firmly believe that the key to superior analytics is putting your selected tools and techniques together in a robust model that can be applied across all markets and time frames, resulting in consistent inferences. However, unless a model is completely 100% automated, the analyst must endeavour to deeply understand both the model's strengths and weaknesses. Just as in the majority of weather forecasting activities where an element of human judgement is required, model and personal refinement year on year is a major consideration.

Simon Maelzer (MSTA, CFTe) is a Global Macro strategist at www.MacroVigilance.com specialising in Alpha generating research. With a strong background in GeoScience, Statistics, Economics and Price Analysis, he has been working in financial market research for over ten years consulting and advising on macro opportunities and associated risk.