Mathematical Challenges to Market Analysis

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There are numerous challenges involved in the mathematical analysis of securities traded in the capital markets. If you are not aware of them, you can waste a lot of time pursuing illusory theories that are doomed to failure. It took me many years to separate the facts from the half-baked assumptions put forth by numerous financial "authorities".

1. Many people assume market price movements are normally distributed. Examination of the data reveals price movements are essentially Cauchy. This means investing risks are far higher than most people think they are. (You can make market price data look normally distributed by throwing out enough of those pesky outliers to limit your chart to ±2 Sigma, but if you use all the data, then the x-axis bounds open to ±10 Sigma for market data. By using all the price change data, you get an entirely different picture. See: Market Prices Versus the Bell Curve)

2. Markets trend (i.e., they display momentum). Even staunch EMH supporters now recognize this. Observing momentum is easy. Objectively gauging momentum is far harder than it looks.

3. Market price movements are noisy. This has led many people to claim they are random. But calculating the correlation dimension and the Kolmogorov Entropy, or the Lyapunov Exponent for market price time series shows results which are not consistent with random time series.

4. Most mathematical functions are continuous (except for unusual things like the Dirichlet function). Market price movements are discrete. When you are using a continuous function to do calculations on discrete data, you are running pea gravel through a meat grinder. As such, you need to keep in mind that the output of the function is fundamentally different from the data that went into the function.

5. People assume markets are linear or quasi-linear systems. Markets are non-linear dynamical systems. Small changes in the inputs to the system can result in surprisingly large changes in the output.

6. People who think of markets as stable systems assume markets will gravitate toward an equilibrium point. Markets are Complex Adaptive Systems, which means whenever the market moves toward equilibrium, it causes the system to adapt, which moves the equilibrium point.

7. Many people assume market price movements are symmetric. They are not. Markets generally advance slowly and make wide, rounded tops. Then they usually decline rapidly and form V-shaped bottoms. Indicators that track the market well on the way up may fail spectacularly when the market turns and heads down.

8. There are cycles in the markets; however, they can be hard to identify and the periods of the cycles can change without warning (i.e., market cycle lengths are not stable).

9. As a result of point 7 and 8, many (if not most) indicators with fixed periods provide erratic results. Sometimes they are profitable and sometimes they get whipsawed.

Just to make things more difficult, markets display characteristics of both Complexity and Chaos. Markets are textbook examples of a Complex Adaptive Systems; however, market price movements give every appearance of being fractal, like chaotic systems. Markets also exhibit self-similarity, like chaotic systems. Furthermore, they shift back and forth between periods of stability and turbulence, just like chaotic systems.