FOREX

*Scale Is In The Eye Of The Beholder*

# Using Scaling Laws For The Development Of FX Trading Models

*Can the fractal properties of financial time data be used to develop effective trading models? Here's a look at using scaling laws, which describe fractal behavior, for the development of trading models for forex.*

Scaling laws arise from systems that have a fractal geometry. Fractals are self-similar systems. What is a "self-similar" system? If a scale is the level of detail as we look at an object, then a self-similar object still looks like itself at different scales. If you look at a branch of a tree, it will have many smaller branches and each branch will also look like a tree, but at a smaller scale. In addition, physical laws are independent of the scale so that the behavior of fractal systems is scale-independent. Common examples of fractal systems are trees, river networks, ferns, lightning bolts, urban cities, and coastlines.

Self-similar systems have no preferred scale and scaling laws will arise when there is no preferred scale. A general scaling law has the form:

$$y = \left(\frac{x}{C}\right)^{D} \qquad \text{Eq. 1}$$

where $C$ is a constant and $D$ is the slope on a log($y$) versus log($x$) plot.

The textbook example of a fractal object is a rugged coastline. The coastline of Norway is often used as a case study. In the following scaling equation, $N$ is the number of segments in the zigzag coastline pattern, $D$ is the fractal dimension, and $r$ is the measurement scale.

$$N \propto r^{-D} \qquad \text{Eq. 2}$$

In 1990, scaling laws were first observed for foreign exchange (FX) rate data. (For more on this, see the article listed in "Further reading" at end, "Statistical Study Of Foreign Exchange Rates, Empirical Evidence Of A Price Change Scaling Law, And Intraday Analysis.") These laws represent the fractal structure of FX rates and can be used to predict the expectation value of key FX exchange rate parameters such as the average return of an up/down trend or the duration of a trend. This information is key to the development of trading models.

## What's ahead

In the following sections, I will first describe three *established* scaling laws for FX data. After showing the importance of volatility in FX data, I'll present three *new* scaling laws that use volatility as the measurement scale. Then, I'll describe the use of volatility scaling laws for model development and I'll show the resultant trade model performance.

## The first three scaling laWs

Let's look at three well-established scaling laws for FX data.

### *First scaling law*

For the first scaling law, a relationship exists between the mean absolute change of logarithmic returns, sampled at time intervals $\Delta t$, and the size of the time interval. The time interval $\Delta t$ can be the chart bar times, such as 5-minute, 15-minute, one-hour, four-

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