

# WAS BENOIT MANDELBROT PLAGIARIZING RALPH ELLIOTT'S WAVE PRINCIPLE?

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ABSTRACT. In February 1999, Benoit Mandelbrot submitted an article to *Scientific American* called "A Multifractal Walk down Wall Street." In it, he discusses how fractal geometry can be used to model the stock market curves. In the following months several letters to the editor appeared claiming that Mandelbrot had plagiarized the work of the economist Ralph Nelson Elliott, who had rigorously sought to understand the stock markets sporadic movement nearly 70 years ago. The task is to understand both Mandelbrot's and Elliott's work and determine if the protestors' claims were valid.

## 1. INTRODUCTION

There is no denying the power that the stock market holds over human interaction and happiness. Its seemingly unpredictable and random behavior has been an enigma mathematicians and economists have grappled to model since the market's creation. Furthermore, its spontaneous nature directs the lives of nearly every individual in the country. Thus, there is no denying the importance for accurate models of the stock market to exist.

Benoit Mandelbrot has been a forerunner of fractal geometry since its conception. He has studied fractal forms in nearly every aspect of nature from galaxies, to measuring the length of a coastline, to the financial movements of the stock market. Mandelbrot felt his fractals could be used to more accurately model the stock market. His main critique was of Portfolio theory, which deals more with gaussian curves of averages and ignores drastic changes in stock market prices. Mandelbrot describes Portfolio theory like a sailor at sea:

If the weather is moderate 95 percent of the time, can the mariner afford to ignore the possibility of a typhoon?

The effect is that Portfolio theory ignores unexpected and drastic fluctuations and seeks an averaging effect. Mandelbrot argues, and I think we can all agree, that this is an inaccurate estimation. His article in *Scientific American* describes his critique of Portfolio theory and his proposal for a better model.

Ralph Elliott was an economist of the first half of the century. This was a time before the term fractal was used to describe curves with the same shape at different time scales. His goal was to rigorously analyze the stock market's movements and accurately predict future trends. Elliott used actual curves of companies to formulate an accurate description that could be repeated for any companies' financial curve. Elliott's findings were similar to what we would call fractals today, but, of course, he does not describe them using that name. His theory was called the Elliott Wave Principle, where waves refer to stock market curves.

## 2. MANDLEBROT'S MULTIFRACTALS

The term fractal, as Mandelbrot uses it in his article, refers to a curve in which distinct parts are smaller scales of the whole curve. He argues that this property characterizes the physical properties of stock market curves. Namely, at different time scales, stock market curves look essentially identical. A multifractal is formed by a curve pattern being repeated at smaller and smaller time scales. For example, Mandelbrot uses a 3 wave pattern, the first and last being in the direction of the general trend, the middle against the general trend. This generic pattern is then modified to fit drastic fluctuations in a process of shortening or lengthening the time axis. A picture of his example is figure 1.

Mandelbrot admits that his techniques do not come closer to forecasting the market, but they more accurately describe it than previous models, specifically Portfolio theory. Another concern that arises is Mandelbrot's lack of specificity when describing the wave patterns. He isn't clear on how to use fractals to decipher the stock market, only that fractals are more effective than previous models in describing the market's behavior. One thing to note: Mandelbrot makes no reference to Elliott. We will now see why he might have done well to have cited Elliott's Wave Principle.

## 3. ELLIOTT'S WAVE PRINCIPLE

Elliott's Wave Principle is a rigorous, thorough analysis of stock market curves. The basic trend is a 5 up, 3 down wave pattern that is shown in figure 2. The figure depicts the general form of one of Elliott's waves. We see five waves in the general direction of the trend, and three moving away from the trend. These three waves are called corrections. We also see the curves given to us by Mandelbrot, which show a striking similarity. Here we see that Elliott has provided detailed and specific patterns that the stock market follows. Obviously, this single pattern cannot account for the vast number of stock market curves, but Elliott counters by providing several specific wave forms to expand the vocabulary for predicting the stock market. He has thoroughly examined market curves and arrived on a list of classifications, rather than providing only a process for modeling the stock market. Elliott's wave's can then be broken into self affine curves identical to the process Mandelbrot uses. This process shows how Elliott had used multifractals to model the stock market. Of course, his work predates the term fractal, nonetheless, properties of stock market curves, no matter what one calls them, are the same now as they were then. Elliott used his analysis in actual stock markets. He dictated the waves and used his principle to predict future trends with accuracy. Elliott completed the bulk of his work in the 1930's predating the term fractal. Regardless, as the pictures show, there is no distinguishing Elliott's wave's from modern day fractals. They describe the same properties of the stock market.

## 4. ANSWER TO THE PROTESTORS

The protestors showed concern over Mandelbrot's apparent plagiarism. After analyzing both theories, there is no question: Mandelbrot should have at least cited Elliott's Wave Principle. Elliott had discussed the same ideas Mandelbrot was stressing nearly 60 years earlier and at a much more thorough and specific level. Mandelbrot didn't argue for a specific pattern as Elliott did, but his goal with

the article was to bring awareness to the scientific community of the importance of fractals in financial curves. Thus, mention of previous work that models the stock market using multifractals is necessary. Mandelbrot probably didn't directly plagiarize Elliott's work, but by not giving credit to Elliott, Mandelbrot cheats his audience of valuable information. Plus, it is slightly pretentious of Mandelbrot to only reference his previous works at the end of the article. No one can deny the massive contributions he has made to mathematics, but even the most brilliant of the brilliant must give credit where credit is due.

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