Volume 2: Handbook #1 – Author Profile: Mandelbrot, Benoit (1924 - 2010)

Perspective: Deliberate Maverick Seeking "*Keplerian Moments*" by Quantifying "*Roughness*"

Benoit Mandelbrot's life history, as told in his autobiography – "*The Factalist*", shows how he accomplished his life-long goal of creating "*Keplerian moments*" in science – i.e. Paradigm-changing, "*Small Worlds*" models that also change the way we look at the "*Large World*".

Historical Context: A History of Survival Through Independent Thinking

Coming from a family of survivors by dint of anticipating problems, and acting on it before it is too late, his parents had to rebuild their lives six times in a row. To paraphrase the chapters in his autobiography as a dual French-American citizen: Born in Warsaw, Poland in 1924; Adolescent in Paris in 1936; Dirt-poor in Vichy France – fearing for his life – in 1939; Student at Ecole Polytechnique ("X", or "Carva") in 1945; Caltech in 1947; French Officer (Air Force) in 1949; Employee at Philips Electronics in 1950; Academic at MIT (1953); Princeton's Institute for Advanced Study (1954); Academic in Paris (1955); Academic in Geneva (1956); Employee at IBM Research (1958); Academic at Yale (1987); Retired in 2004 with many side-trips, conferences, and awards along the way.

Purpose: How to Quantify When to Build Larger Margins of Safety

In general: The quantification of complex objects as dynamic processes. In particular: He developed, and named the quantification of "*Roughness*", i.e. "*Fractals*", as an addition to Physics' existing quantifications of "*Shape, Color, Sound, Mass, & Temperature*". Its application to Finance means understanding the nature of ***Mandelbrot's*** "*Wild Random Jumps*" as contrasted with ***Bachelier's*** "*Mild Random Walk*" in order to decide when & what to buy, hold, or sell.

Methodology Choices: Seeing How Change Comes in Clusters

Solving quantitative problems, and seeing hidden connections through geometric intuition.

Foundational assumptions: Black Swans Matter

Expanding the applicability of a theory to the real-world by removing the number of limiting assumptions. For instance, in the case of Finance, removing the assumptions of independence, and normality from the model of Brownian Motion in order to create the model of Multifractal (time & space) Motion. The poor fit that comes from the application of the traditional "*Small Worlds*" mathematical tools of the ***Logic & Statistics Program*** to "*Large World*" problems rests on specific "*Axioms, Assumptions & Hypotheses*" that include: (i) The structure of the decision "*Task Environment*" ("*Games of Chance*"), (ii) The capabilities of the "*Decision-Maker*" ("*Rational Investor*"), and (iii) The process of decision-making ("*Game Theory*"). These specific "*Axioms, Assumptions & Hypotheses*" include the frequent invocation of the Normal Distribution to simplify calculations. However, empirical evidence in the "*Large World*" shows that while the "*Mild Randomness*" of the Normal Distribution may be a convenient tool to simplify calculations, it does not match observations in real life. The identification and formalization of up to seven different types of randomness starts in 1964 with ***Benoit Mandelbrot'***s presentation to the Internal Congress for Logic, titled: "*The Epistemology of Chance in Certain Newer Sciences*", followed by his 1997 book "*Fractals and Scaling in Finance"* where he states that the book's ambition is *"… to provide more effective ways to handle relatively rare events that have very strong effects*".

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Sources:
Mandelbrot, Benoit (2012), *The Fractalist, Memoir of a Scientific Maverick*, Pantheon Books
Mandelbrot, Benoit (2010), *Fractals and Scaling in Finance: Discontinuity, Concentration, Risk*, Springer
Mandelbrot, Benoit (2004), *Fractals and Chaos, The Mandelbrot Set and Beyond, Selecta Volume C*, Springer

Meaning: Build Higher Margins of Safety
Echoing, ***Korzybski's*** "*The Map is not the Territory*", ***Mandelbrot*** shows how models are not the reality, and develops quantifications that improve the directions that one can safely give, or follow as an individual decision-maker. In Finance, he shows that scaling models of changes in asset prices based on the "*Axioms, Assumptions & Hypotheses*" of continuity, independence, and normality – such as ***Bachelier's*** "*Random Walk*" (Brownian Motion) - understate the nature and the level of price changes. Instead, he developed models that do not depend on making such assumptions to show that price changes exhibit intermittent discontinuities (Jumps), and non-normality (Fat Tails). ***Mandelbrot's*** spectrum of randomness provides a scale to understand the applicability of various programs including the ***Logic & Statistics Program, the Heuristics & Bias Program, Ergodicity Economics, and the "****Fast & Frugal****" Heuristics Program***.
Mandelbrot's seven states of randomness break into three categories: (i) "*Mild*" – analogous to solids in Physics, (ii) "*Slow*" – analogous to liquids, and (iii) "*Wild*" – analogous to gases. ***Mandelbrot*** describes the seven states of randomness as follows: (1) Proper "*Mild Randomness*", such as the Normal Distribution, (2) "*Borderline Mild Randomness*", including specific Exponential Distributions, (3) "*Delocalized Slow Randomness*", (4) "*Localized Slow Randomness*", such as Lognormal Distributions, (5) "*Pre-Wild Randomness*", including specific Pareto Distributions, (6) "*Wild Randomness*", including specific Pareto Distributions, and (7) "*Extreme Randomness*", where all moments are infinite such as the Log-Cauchy Distribution. As you can see from **Mandelbrot's** list, the Lognormal Distribution, commonly assumed to provide a better model for the behavior of prices of risky assets than the Normal Distribution, takes us away from "*Mild Randomness*", and its traditional "*Axioms, Assumptions & Hypotheses*". **Mandelbrot's** focus on "*Discontinuity*" and "*Concentration*" marks a change in perspective from modeling randomness as a measurement error, to modeling randomness as a structural feature of the nature of reality. It also led him to create and develop the new field of "*Fractals*", a quantitative measure of "*Roughness*". **Mandelbrot** explains that financial reality shows "*Random Jumps*" rather than "*Random Walks*". This suggests the existence of material model risk in financial theories based on "*Mild Randomness*", such as ***Modern Portfolio Theory***. **Nassim Nicholas Taleb** popularized the existence and the consequences of non-"*Mild Randomness*" in his books, ranging from "*Fooled by Randomness*" in 2002, to "*Statistical Consequences of Fat Tails*" in 2020. He branded rare events with outsized consequences – "*Black Swans*". While **Mandelbrot** showed the presence of material model risk deriving from the assumption of "*Mild Randomness*" in the early 1960s, modeling tools that take "*Slow*" or "*Wild*" Randomness into consideration have yet to become best practices on the retail side of the financial industry. Consider the slow pace of best practice development for "*Tools*" such as "*Parametric Statistical Inference*" as an example of the diffusion speed of quantitative innovations in the real-world: Based on "*Mild Randomness*", and started with **Laplace** in 1774, followed by two revolutionary re-conceptualizations, "*Parametric Statistical Inference*" achieved best practices status in 1956 – a span of nearly 200 years. Based on this example, one can expect that it will take a long time before mainstream financial models for individual decision-making evolve from ***Bachelier*** *(1900)* to ***Mandelbrot*** (*1963*), thus opening differentiated advantages for early adopters.