# Book Excerpt: Today's Pressing Problem in Quantitative Finance

The massive misuse of quantitative models by financial analysts, executives and regulators is our greatest challenge.

**By Joe Pimbley**

Numerous tools of operations research (OR) – including mathematical modeling, optimization, simulation, statistical analysis of data and computing – are directly applicable to the study and functioning of financial markets. As it happens, adding value and conquering challenges of the financial world require much more than straight OR expertise.

The basic unit of finance is not the U.S. dollar or a bit of data or a barrel of oil. Rather, it is the person - whether as investor; speculator; trading algorithm developer; accountant; floor trader; salesperson; regulator; hedge fund manager; lawyer; "white knight;" risk executive; or any other human-populated role.

The quantitative methods of OR must understand and incorporate the actions of these units – these people. The skill-set diversity of financial professionals is tremendous.

At a minimum, to understand and to communicate problems and solutions, the OR professional entering the financial world must speak as many of the "basic unit" languages as possible. Creating new knowledge with quantitative analysis for our financial colleagues is tantalizing, because such projects invariably seek and find our weaknesses.

For derivative valuation models, we must understand how dealers run their businesses. To improve a bank's simulation technique to determine its own capital adequacy, we must become expert in *identifying* and *acquiring* – not just *analyzing* – necessary data.

Above all else, our contributions are worthless if we cannot explain them to our diverse colleagues.

## Primacy of People

The primacy of people in the financial world, as opposed to laws of nature, has an additional painful, but exhilarating, consequence. Data and information are not what they seem.

The financial world is all about *marketing/best foot forward* /*hide the problems* and *obfuscate true cause-and-effect* – because that's how human organizations operate. Traders, for example, guard their information from their own managers and executives. A salesperson offering a new bond deal will tell a useful story that one should not consider accurate. Similarly, a hedge fund that proclaims its profitable deployment of "chaos theory" is almost certainly not making money in chaos theory – otherwise there'd be no such public disclosure. As OR professionals, it is imperative to see the world for what it truly is. Hence, to add value, we must become expert in the financial areas of our contributions.

We must learn as best we can, for example, how and why loan defaults happen when building loan credit risk models. We learn by talking to the risk analysts and loan traders closest to this subject – but we must temper this information with our own reading, modeling and testing.

The exercise requires significant judgment regarding the validity and utility of information and data from various sources. In other words, we must learn the field we're "attacking;" make our own determinations of who and what to believe; and then work even harder to communicate what we've created to a broad spectrum of colleagues.

## History, Simulations and Models of Mathematical Finance

Tracing the history of mathematical finance gives an apt summary of the topic. Back in 1973, of course, Fischer Black and Myron Scholes made a pathbreaking contribution for valuing equity options. Subsequently, Cox and Ross discovered a "risk neutrality" concept, while Harrison and Pliska established an alternate mathematical framework that defines much of the application of mathematics to derivative valuation. The overarching imperative for proper analysis is the principle of "hedge construction."

Financial simulations are ubiquitous due to the stochastic nature of underlying market variables. There are two types of common simulations with attendant mathematical concepts: "valuation" and "risk."

In the valuation type, one employs simulation to solve numerically for a derivative value. Risk, on the other hand, estimates the future probability density function of the value of a portfolio of investments that have known initial value. This portfolio may consist of equities, bonds, currencies, commodities and derivatives relating to these market variables.

For the financial world context, a model can be defined as a framework of rules, relationships and calculation steps that employs specified input information to give output results. Models often employ "mathematical finance" techniques and/or simulation methods, and run the gamut from simple to complex. Ubiquitous in finance, models are the means that people use to convert financial data to plausible summaries and decisions.

The greatest applications of mathematical finance pertain to valuation and risk assessment for assets and derivatives. Valuation is a seemingly straightforward concept: the value of a long position in an asset is merely the best price the owner receives in selling the asset. But the absence of observable transactions in many markets often transforms this "best price" determination into a quantitative, model-based judgment.

**Pressing Problem**

. Models are useful primarily if builders and users (1) act in good faith; (2) understand that model results have limited and varying precision; and (3) employ models primarily for learning, judgment and testing the completeness and quality of input data. Massive violation of some or all of these tenets is the "pressing problem" of the global financial community.

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