VOLUME - 15, ISSUE - 01, JANUARY - 2026 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper Commerce

FINANCIAL ENGINEERING HISTORY: Q VERSUS P

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ABSTRACT

Financial engineering is a multidisciplinary field involving financial theory, methods of engineering, tools of mathematics and the practice of programming. It has also been defined as the application of technical methods, especially from mathematical finance and computational finance, in the practice of finance. Financial engineering plays a key role in a bank's customer-driven derivatives business delivering bespoke OTC-contracts and "exotics", and implementing various structured products which encompasses quantitative modelling, quantitative programming and risk managing financial products in compliance with the regulations and Basel capital/liquidity requirements. An older use of the term "financial engineering" that is less common today is aggressive restructuring of corporate balance sheets Computational finance and mathematical finance both overlap with financial engineering. Mathematical finance is the application of mathematics to finance. Computational finance is a field in computer science and deals with the data and algorithms that arise in financial modeling. Financial engineering draws on tools from applied mathematics, computer science, statistics and economic theory. In the broadest sense, anyone who uses technical tools in finance could be called a financial engineer, for example any computer programmer in a bank or any statistician in a government economic bureau. However, most practitioners restrict the term to someone educated in the full range of tools of modern finance and whose work is informed by financial theory. It is sometimes restricted even further, to cover only those originating new financial products and strategies. Despite its name, financial engineering does not belong to any of the fields in traditional professional engineering even though many financial engineers have studied engineering beforehand and many universities offering a postgraduate degree in this field require applicants to have a background in engineering as well. In the United States, the Accreditation Board for Engineering and Technology (ABET) does not accredit financial engineering degrees.

KEYWORDS : FINANCIAL ENGINEERING

INTRODUCTIONS

In the United States, financial engineering programs are accredited by the International Association of Quantitative Finance. Quantitative analyst ("Quant") is a broad term that covers any person who uses math for practical purposes, including financial engineers. Quant is often taken to mean "financial quant", in which case it is similar to financial engineer. The difference is that it is possible to be a theoretical quant, or a quant in only one specialized niche in finance, while "financial engineer" usually implies a practitioner with broad expertise. "Rocket scientist" (aerospace engineer) is an older term, first coined in the development of rockets in WWII (Wernher von Braun), and later, the NASA space program; it was adapted by the first generation of financial quants who arrived on Wall Street in the late 1970s and early 1980s While basically synonymous with financial engineer, it implies adventurousness and fondness for disruptive innovation. Financial "rocket scientists" were usually trained in applied mathematics, statistics or finance and spent their entire careers in risk-taking. They were not hired for their mathematical talents, they either worked for themselves or applied mathematical techniques to traditional financial jobs. The later generation of financial engineers were more likely to have PhDs in mathematics, physics, electrical and computer engineering, and often started their careers in academics or non-financial fields.

Criticisms

One of the prominent critics of financial engineering is Nassim Taleb, a professor of financial engineering at Polytechnic Institute of New York University who argues that it replaces common sense and leads to disaster. A series of economic collapses has led many governments to argue a return to "real" engineering from financial engineering. A gentler criticism came from Emanuel Derman who heads a financial engineering degree program at Columbia University. He blames over-reliance on models for financial problems; see Financial Modelers' Manifesto.

Many other authors have identified specific problems in financial engineering that caused catastrophes:

1. Aaron Brown named confusion between quants and regulators over the meaning of "capital".
2. Felix Salmon gently pointed to the Gaussian copula
3. Ian Stewart criticized the Black-Scholes formula.
4. Pablo Triana along with others including Taleb and Brown) dislikes value at risk.
5. Scott Patterson accused quantitative traders and later high-frequency traders.
6. Douglas W. Hubbard notes that the Black–Scholes formula, along with modern portfolio theory, makes no attempt to explain an underlying structure to price changes.
7. James Rickards posits that the "key assumptions" underpinning financial risk management are flawed.
8. Richard Bookstaber submits that the more intricate risk-management structures may actually make the financial system more vulnerable.

The financial innovation often associated with financial engineers was mocked by former chairman of the Federal Reserve Paul Volcker in 2009 when he said it was a code word for risky securities, that brought no benefits to society. For most people, he said, the advent of the ATM was more crucial than any asset-backed bond.

financial engineer" to refer to a graduate in the field. The financial engineering program at New York University Polytechnic School of Engineering was the first curriculum to be certified by the International Association of Financial Engineers. The number, and variation, of these programs has grown over the decades subsequent (see Master of Quantitative Finance § History); and lately includes undergraduate study, as well as designations such as the Certificate in Quantitative Finance.

Mathematical finance, also known as **quantitative finance** and **financial mathematics**, is a field of applied mathematics, concerned with mathematical modelling in the financial field. In general, there exist two separate branches of finance that require advanced quantitative techniques: derivatives pricing on the one hand, and risk and portfolio management on the other. Mathematical finance overlaps heavily with the fields of computational finance and financial engineering. The latter focuses on applications and modelling, often with the help of stochastic asset models, while the former focuses, in addition to analysis, on building tools of implementation for the models. Also related is quantitative investing, which relies on statistical and numerical models (and lately machine learning) as opposed to traditional fundamental analysis when managing portfolios.

French mathematician Louis Bachelier's doctoral thesis, defended in 1900, is considered the first scholarly work on mathematical finance. But mathematical finance emerged as a discipline in the 1970s, following the work of Fischer Black, Myron Scholes and Robert Merton on option pricing theory. Mathematical investing originated from the research of mathematician Edward Thorp who used statistical methods to first invent card counting in blackjack and then applied its principles to modern systematic investing

History: Q versus P

There are two separate branches of finance that require advanced quantitative techniques: derivatives pricing, and risk and portfolio management. One of the main differences is that they use different probabilities such as the risk-neutral probability (or arbitrage-pricing probability), denoted by "Q", and the actual (or actuarial) probability, denoted by "P".

Derivatives Pricing: The Q World

Goal	"extrapolate the present"
Environment	risk-neutral probability
Processes	continuous-time martingales
Dimension	low
Tools	It calculus, PDEs
Challenges	calibration
Business	sell-side

The goal of derivatives pricing is to determine the fair price of a given security in terms of more liquid securities whose price is determined by the law of supply and demand. The meaning of "fair" depends, of course, on whether one considers buying or selling the security. Examples of securities being priced are plain vanilla and exotic options, convertible bonds, etc.

Once a fair price has been determined, the sell-side trader can make a market on the security. Therefore, derivatives pricing is a complex "extrapolation" exercise to define the current market value of a security, which is then used by the sell-side community. Quantitative derivatives pricing was initiated by Louis Bachelier in *The Theory of Speculation* ("Théorie de la spéculation", published 1900), with the introduction of the most basic and most influential of processes, Brownian motion, and its applications to the pricing of options. Brownian motion is derived using the Langevin equation and the discrete random walk. Bachelier modeled the time series of changes in the logarithm of stock prices as a random walk in which the short-term changes had a finite variance. This causes longer-term changes to follow a Gaussian distribution.

The main quantitative tools necessary to handle continuous-time Q-processes are Itô's stochastic calculus, simulation and partial differential equations (PDEs).

Risk And Portfolio Management: The P World

Goal	"model the future"
Environment	real-world probability
Processes	discrete-time series
Dimension	large
Tools	multivariate statistics
Challenges	estimation
Business	buy-side

Risk and portfolio management aims to model the statistically derived probability distribution of the market prices of all the securities at a given future investment horizon. This "real" probability distribution of the market prices is typically denoted by the blackboard font letter as opposed to the "risk-neutral" probability used in derivatives pricing. Based on the P distribution, the buy-side community takes decisions on which securities to purchase in order to improve the prospective profit-and-loss profile of their positions considered as a portfolio. Increasingly, elements of this process are automated; see Outline of finance § Quantitative investing for a listing of relevant articles.

For their pioneering work, Markowitz and Sharpe, along with Merton Miller, shared the 1990 Nobel Memorial Prize in Economic Sciences, for the first time ever awarded for a work in finance.

The portfolio-selection work of Markowitz and Sharpe introduced mathematics to investment management. With time, the mathematics has become more sophisticated. Thanks to Robert Merton and Paul Samuelson, one-period models were replaced by continuous time, Brownian-motion models, and the quadratic utility function implicit in mean variance optimization was replaced by more general increasing, concave utility functions. Furthermore, in recent years the focus shifted toward estimation risk, i.e., the dangers of incorrectly assuming that advanced time series analysis alone can provide completely accurate estimates of the market parameters.

Today many universities offer degree and research programs in mathematical finance.

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In engineering, modelling always serves a particular goal. For example, the lightning protection of aircraft can be modelled as an electrical circuit, in order to predict whether the protection will still work in 30 years, given the ageing of its electrical components. However, this perfection comes at a price.

REFERENCE'S

1. Marek Capiski and Tomasz Zastawniak, Mathematics for Finance: An Introduction to Financial Engineering, Springer (November 25, 2010)
2. David Ruppert, Statistics and Data Analysis for Financial Engineering, Springer
3. "MS in Financial Engineering". *Columbia University Department of Industrial Engineering and Operations Research.*
4. Tanya S. Beder and Cara M. Marshall, Financial Engineering: The Evolution of a Profession, Wiley (June 7, 2011)
5. Qu, Dong (2016). Manufacturing and Managing Customer-Driven

Derivatives.
6. Robert Dubil, Financial Engineering and Arbitrage in the Financial Markets, Wiley (October 11, 2011)
7. "What is Financial Engineering?". *International Association of Financial Engineers. Archived from* the original *on 2012-06-30*.
8. Ali N. Akansu and Mustafa U. Torun. (2015), A Primer for Financial Engineering: Financial Signal Processing and Electronic Trading, Boston, MA: Academic Press,
9. Salih N. Neftci, Principles of Financial Engineering, Academic Press (December 15, 2008) 978-0123735744
10. Entry requirements | Imperial College Business School. 2016. Entry requirements | Imperial College Business School. [ONLINE] Available at: http://wwwf.imperial.ac.uk/business-school/programmes/msc-risk-management/entry-requirements/ Archived 2016-06-27 at the Wayback Machine. [Accessed 30 June 2016].
11. www. Wikipedia journals