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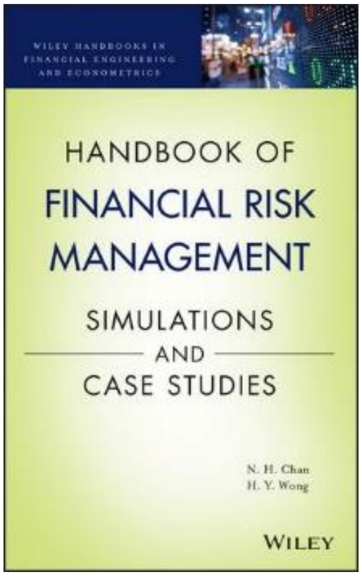

Book Review:

Handbook of Financial Risk Management: Simulations and C

By: N.H. Chan and H.Y. Wong (The Chinese University of Hong Kong)

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The United States subprime mortgage crisis was a multinational financial crisis that occurred between 2007 and 2010 that contributed to the global financial crisis. It demonstrated that widely adopted risk management instruments, such as Credit Default Swaps (CDS), Collateralized Debt Obligation (CDO), and other CDO's, can be amplifiers instead of mitigators of risk. Headlines such as "Did a mathematical formula really blow up Wall Street...?" and "Living on the edge" became the norm. What really happened in 2008...? The answer and verdict are yet to be found.

The deadly combination of bad prices, overconfidence in mathematical models, and non-transparency of market makers, reinforced by an overlay of scientific respectability for questionable models, ultimately resulted in a global financial tsunami. Does this mark the death of the "quants...?" Not yet. Financial crises come and go. Some carry on over the short term, others (such as that of 2008) over the long term. These crises have not stopped financial institutions from creating and trading new derivative products, in the same way that sicknesses have not stopped medical developments. Modern financial markets would be too simple without derivatives; after all, derivative products are useful devices for reducing and hedging risks. Moreover, strong competition among financial institutions requires derivatives to offer extra profits. Against such a background, how market practitioners evaluate derivative products in an effective and transparent manner is a key issue. The market clearly requires quantitative skills, meaning, quants are here to stay.

Contrary to the opinion that demand for quantitative skills in the pro-crisis era would decrease due to the collapse of large-scale investment banks, demand in the commercial banking and risk management sectors has actually increased. In the past, major *investment banks* (i-banks) have been market makers of Over- the-Counter (OTC) derivative products. The creation, valuation, and risk management of OTC derivatives are collectively offered by a handful of *i-banks*, which usually employ quantitative professionals to perform such tasks. These highly educated talents are usually known as "quants" in the financial industry. Before the crisis, regional banks had no particular interest in hiring quants because they did not have large-risk exposure in the OTC market. They engaged in the OTC derivatives market mainly through "*back-*

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to-back" deals in whichregional banks purchased OTC product portfolios for their clients upon request. These portfolios were packaged by *i-banks*, and contracts were established between the *i-banks* and the clients. The regional banks acted as intermediary agents and earned commissions from such deals. Neither the clients nor the regional banks anticipated the bankruptcy of *i-banks*. When "Lehman Brothers" went down in 2008, followed by a number of other financial institutions, both the regional banks and their clients were suddenly exposed to an unprecedented scale of loss they had never anticipated.

To make matters worse, some regional banks faced litigation due to the unclear or nontransparent explanations of the risks embedded in many of the derivative products. Many of these banks had to settle lawsuits out of court and pay off huge losses. As a result, the share prices of these banks dipped more than 50%, and many have not yet recovered. The post-crisis regulations have since required financial institutions to report their investment risks when embracing back-to- back deals. This partly explains the surge in demand for quantitative risk managers in the regional banking industry.

Like other major financial markets, Hong Kong also witnessed the rapid growth of this demand based on the number of student applications made to quantitative oriented financial programs. That were eager to acquire practical quantitative risk management skills for their daily work. Although there are excellent t modern financial theory and mathematical finance, many are either too elementary or too abstract and cannot bridge the gap between theory and application.

This handbook series back in 2008, was planned as a book that offered practical computational examples using real datasets. If anything is to be learned from the 2008 calamity, it is that it offered a tremendous amount of information and data to illustrate many of the computational issues encountered in modern finance, albeit in a very painful and costly manner. In light of the gain-maximization rationale on Wall Street that drives financial practitioners ever closer to their ethical boundaries, the market needs practitioners to be scientifically critical, socially honest, and adherent to the highest ethical standards to resist temptation. The worked examples in this book comprise real financial products in the OTC market. Using data taken from the subprime credit crisis period, the pros and cons of different models are demonstrated.

Case studies are provided to illustrate the discrepancies arising from different models for the same product. Many examples take the form of questions raised by students and practitioners alike when faced with a particular scenario while pricing certain financial instruments. What follows is a brief synopsis of each chapter of this book. Modern financial products can hardly be modeled by pencil and paper alone, as they require large-scale computations. Although there is a multitude of possible software choices, Excel Visual Basic for Application (VBA) is used in this book due to its wide applicability. Readers are not assumed to have a strong background in VBA, but some exposure to computer programming would be helpful.

Excel VBA is probably the most commonly used computational tool in financial institutions, particularly when a new model is tested at a preliminary stage within a division. Many traders use Excel VBA to compute their trading strategies. Some data providers allow users to update information in real time using the Excel format. Excel VBA thus allows traders and risk managers to implement their solutions conveniently in real time. It is a programming language that enhances the applicability of MS Excel by enabling the users to instruct Excel to perform tasks automatically. As most of the programs in this book are written in VBA, a brief introduction to VBA is provided in this opening chapter. Although we do not assume that readers have prior programming knowledge, programming experience in other languages would be helpful. For readers already familiar with VBA, this chapter serves as a refresher and quick reference. A list of the functions defined throughout the book can be found at the end of the chapter. These functions not only improve readability and traceability but also simplify the programs.

Although this book consists of many worked numerical examples, readers have to incorporate theoretical notions, such as Martingale Theory, change of measure, and Stochastic Differential Equations (SDE), with practical implementations to remain scientifically critical. A stochastic process "X" $\{X_t : t \in T\}$ is a collection of real-valued random variables indexed by "t"; that is, for any "t" $\in T$, X_t is a random variable that follows a certain distribution. The index "t" is usually regarded as the time at which the stochastic process is observed. If "t" takes a countable number of values, for

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example, $T = \{1, 2, 3, . ..\}$, then "X" is called a discrete-time stochastic process. If "t" takes a continuum of values, for example, T = [0, T] for some $T > 0$, then "X" is called a continuous-time stochastic process.

Although this is technical in nature, it is not intended to provide a compre- hensive theoretical background. For example, the technical conditions for the existence of a strong, unique SDE solution are not given in this book. Many excellent texts have been written on the subject, and readers are encouraged to consult them for more detailed information. The main purpose is to offer a concise and useful introduction to some of the most important theoretical issuesin modern finance. After making their way through beginning chapters, readers will garner an appreciation for the celebrated Ito's formula and the change of measure techniques, both of which are useful devices in designing simulation strategies.

There is a simulation of structured products using the Black–Scholes model and reviews their pricing and decomposition. Examples, including an Foreign Exchange (FX) accumulator (which caused CITIC Pacific to suffer a huge loss during the 2008 crisis), are used throughout this book. Practitioners are well aware of the inadequacy of the Black–Scholes model. For example, it fails to capture the "*implied volatility smiles*" observed in the market. There are several alternative models to capture implied volatility smiles.

There are explanations that collectively refers to these models as volatility modeling. As no (simple) framework exists to unify these models, they are presented one by one to illustrate their similarities and discrepancies. Different models serve different purposes. For financial products contingent on an index, practitioners prefer a model that replicates the observed market option prices. In turn, the replication relies on the calibration of model parameters by minimizing the difference between model and market prices. Popular models of this kind include the local and stochastic volatility models. For financial products contingent on individual stocks that have limited or no traded options, the selected model can only be fitted using the historical prices of the underlying stock. In such cases, we have to estimate the underlying parameters statistically. One popular model in this approach is the GARCH option-pricing model. GARCH model originated by Engle in1982. The jump-diffusion model is also useful, but its estimation requires the use of Bayesian methods. We can examine the pricing of an accumulator using these models.

Interest rate instruments are perhaps more important than equity derivatives in today's market. The use of detail the interest rate models and their implementations. Deals with the short-rate model, which is useful for fixed- income derivatives on a single interest rate, such as the 3-month rate. In practice, many regional banks lack the in-house software required to build yield curves and instead rely on the yield curves provided by data vendors. However, when the regional bank acquires a proprietary dataset of fixed-income prices, it may not be able to purchase the yield curve from external vendors, and yield curve building poses a hurdle for further analysis. With this in mind, the book introduces several yield curve building models, and computer codes are also provided. Implementation of the Hull–White short-rate model that incorporatesthe super-calibration into the yield curve information is also discussed in this book.

Complicated interest rate derivatives involve several interest rates in their pay- off functions. Typical examples are options related to swap rate, which is a combination of interest rates with different tenors. The market usually uses the London Inter Bank Offered Rate (LIBOR) market model in this situation. In addition to fitting the yield curve, the LIBOR market model views the prices of caps, floors, and swaptions in the OTC market as the data input to calibrate its parameters. The prices and risks of complicated interest rate products are then evaluated using the simulation technique. Such a simulation requires the change of measure technique.

Credit risk and credit derivatives are discussed in this book. One of the most intriguing concepts in finance is how to use a *copula* to value multi-asset credit derivatives such as CDOs. A numerical demonstration of the copula approach is given to illustrate the *pros* and *cons* of modeling credit correlation risk. Post- crisis regulations require banks to report the counter-party risks of OTC products by adjusting the market values to reflect the credit risk. Such an adjustment can be used to determine the amount required in the margin account to guarantee smooth transactions. The difference between the adjusted and non-adjusted prices of the market value is known as the Credit Value Adjustment (CVA). For regulatory purposes, risk managers are obviously interested in the CVA.

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After the prices are computed, the next step is to report the risk through a single quantity, such as the Value-at-Risk (VaR), on a daily basis. Although VaR is not a completely satisfactory risk measure, it has long been a standard benchmark for summarizing risk in the industry. When computing VaR, one faces the challenge of unstable Greek estimations. Because Greeks are partial derivatives of the value of a portfolio with respect to risk factors, they have to be calculated via simulation.

Although this book was published almost ten years ago, the various theories and examples presented are still relevant to the current state of financial management, especially in risk management.

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