





The pivotal theoretical result for asset valuation is the Fundamental Theorem of Finance, invented in 1931 by Bruno de Finetti, [14]. The result takes the premise from the ancient principle

portfolio at a given point in time can possibly give rise to a gain 7 Td [(p)-27(orturen)-340(time)-341v  
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(viii) Analyze historically realized risk-factor series and model the systematic discrepancies from the inferred probabilistic models with the objective of finding model adjustments to achieve

pioneering works on the mathematical theory of Brownian motion, preceding by five years the Physics paper by Einstein [17] and [30].

of derivative valuation theory. The ability to express prices as discounted expectations is mistakenly presented as a consequence of the ability to replicate. To reinforce the message, the overwhelming majority of textbooks follows John Hull's bestseller [23] and go to great lengths to narrow down the focus of attention on models which theoretically admit exact replication: namely, either variations on the binomial lattice model or models based on diffusion processes in the continuum.

The situation was further complicated by technology limitations. In fact, in the 1970s it would have been technically very difficult to use models with no analytical tractability. Since stochastic calculus provides examples of analytically tractable models which also admit replication, the widespread use of complex models in the 1970s of complex models is a natural consequence of the use of stochastic calculus. The widespread use of complex models in the 1970s is a natural consequence of the use of stochastic calculus.

John Hull's book is the classic of models which led to the widespread use of complex models in the 1970s.

armed forces



such as ten business days, directly on the basis of historical returns over a time window of about 500 days.

(v) Individual instruments in a portfolio are valued along with endogenous and exogenous



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proved effective and others are not. The other focus is to build computational strategies to broaden as much as possible the range of decidable questions arising in valuation.

In Finance, decidability is a concept of paramount importance. If a mathematical framework is weak, the range of questions that can be decided is inadequate. Since decisions are taken on

As he laid down the axioms for probability theory and extrapolating by analogy, he proposed that in nitary logic would provide useful shortcuts without counter-indications. The appellative expedient in Kolmogorov's original article however, was rapidly forgotten. As a result, mathe-

SIMD multi-processors are strong at executing tasks which can be carefully planned and where it does not hurt to synchronize blocks of threads executing the same logic. Thread synchronization is advantageous for operations like reading and writing entire pages to and from memory. Scenario generation cannot take advantage of this, and as a rule requires random memory access. However, matrix manipulations such as multiplication are ideal for SIMD multi-

The special functions which are by far most common are the hypergeometric ones, written as expansions with coefficients of a special algebraic form depending on three parameters. Special cases of hypergeometric functions include trigonometric functions, exponentials and logarithms,

time very finely, respecting the so-called CFL condition, from the names of Courant, Friedrichs and Lewy. As many textbooks of numerical analysis explain, the CFL condition was considered impractical to the point of being called a curse. Numerical analysis as a discipline thus developed around the task of avoiding the CFL condition by constructions of discretisation schemes

prepared by human computers, the technology of his time.

GPUs were devised for the requirements of the games market. Now that this technology



as it should.

Analytic solvability, or existence of asymptotic expansions or other properties that facilitate calibration or estimation, pose severe constraints on model flexibility. This leads to the inability to calibrate consistently against the entire spectrum of liquid securities within the horizon of price discovery.

For instance, it is plainly wrong to keep equity derivative model estimation separate from credit model calibration. If the underlying reference name is the same, modelling can, and should be, coalesced into a single defaultable credit-equity model for both sides of the market. This task is feasible as long as a sufficient degree of modelling flexibility is allowed.

Had credit and equity markets been tied together at the modelling level, the crisis would have





and work around system latency with local pre-processing loops. In an architecture based on





To summarize, we propose to:

- (i) Insist on theoretical consistency based on the Fundamental Theorem of Finance. Unless a framework is demonstrably consistent, it should not be used for the purpose of assessing capital adequacy on a mark-to-market basis, but instead should use a more prudent insurance style, mark-to-risk analysis.
- (ii) Recognizing that hedging strategies are articulated across an array of positions extending over multiple time horizons, simulations need to be performed dynamically and consistently



and senior management teams.

Because investment banking is not dealing with physical products in the way that other

be able to innovate and new businesses can leapfrog competitors who do not adopt and fully exploit this technology.

## **11 Conclusions**

In this article we discuss our view of the future of risk management. The combination between

[7] D. Brigo and A. Capponi, *Bilateral Counterparty Risk Valuation with Stochastic Dynamical*

Encyclopedia Britannica Online Edition, 2010, 1847.

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