Time After Time

You can always count on Espen Haug to deliver something thought provoking, and in this issue he does just that. Recent years have seen Espen focusing much of his attention on the boundaries of physics, and as part of this journey we have the cover story "Space-Time Money." It is now normal to consider matters of finance in terms of microseconds (MIFID II, for example, requires microsecond timestamp precision in high-frequency trades) and nanoseconds (NASDAQ operates with timestamp resolution at one billionth of a second).

"In spite of these advances," Espen writes, "the market for short-duration loans has not taken advantage of the revolutionary developments in precision time-keeping technology. The shortest loans are overnight loans, and their maturities are calculated on a different timescale than the one currently used for timestamps on security transactions. In terms of the technology itself, it is certainly possible to adjust the timescale for loan maturities to microseconds, or even below that, but to our knowledge no efforts have been initiated or completed yet. Nevertheless, in the future, we expect that the maturity timescale for short-term loans will shift to the timescale used in high-frequency trading, or lower. This article will explore these ideas around technology, time, and duration, and will explain the implications for our concept of the time value of money."

The market for short-duration loans has not taken advantage of the revolutionary developments in precision time-keeping technology.

Short-term loans with maturities of microseconds – thought proving enough for you?

Here's another question worth asking, courtesy of Aaron Brown: "Did the Financial Crisis Kill Fama–French?" In order to explore this, Aaron uses a six-factor version of Fama–French with reference to the periods 1963–2009 and the post-financial crisis period to the present.

In "Sustainable Investing: Encouraging Evidence for Investors," Gabriel Herrera and Michael Brenneis present results from their research into whether sustainable investing is a positive or negative contributor to outperformance, and how patient investors need to be to capitalize on any positive effects.

Uwe Wystup takes to the skies in this Issue, with "Derivatives Risk Management and Aviation," suggesting that taking a tip from aviation risk management can prevent us from being penny wise, pound foolish.

Rolf Poulsen invites us into the classroom with "Things I Learned This Semester, Part Deux." In particular, Rolf says: "it is a chronological report from the university teaching trenches defending against COVID-19. It remains to be seen if it will all be over by Christmas."

In "The Panacea of Science and Technology," Rudi Bogni warns "about the senseless hype about science and technology by politicians who would not be able to recognize a partial differential equation or a Poisson distribution if their life depended on it."

A moment of rediscovery and reflection is always worthwhile, and this comes courtesy of Albin Spinner in this Issue, in "Model or Prophecy?" Merton Senior or Merton Junior? Too cryptic? Read the article!

"The Covid-19 Crash in the US Stock Market" is Bill Ziemba's exhaustive look at the VIX and S&P500, with a few slices of AAPL up to June 2020. Great insight and commentary on the dynamics at play during this extraordinary period.

In "Swap Rate à la Stock: Bermudan Swaptions Made Easy," Dariusz Gatarek and Juliusz Jabłecki show how Markovian projection, together with some clever parameter freezing, can be used to reduce a full-fledged local volatility interest rate model, such as Cheyette (1992), to a "minimal" form in which the swap rate evolves essentially like a dividend-paying stock. Using a number of numerical examples, the author compares such a minimal "poor man's" model to a full-edged Cheyette local volatility model and the market benchmark Hull–White one-factor model. Numerical tests demonstrate that the "poor man's" model is, in fact, sufficient to price Bermudan interest rate swaptions. The main practical implication of this finding is that – once local volatility, dividend, and short-rate parameters are properly stripped from the volatility surface and interest rate curve – one can readily use the widely popular equity derivatives software for pricing exotic interest rate options such as Bermudans.

In "The Transport-based Mesh-free Method: A Short Review," Philippe G. LeFloch and Jean-Marc Mercier

introduce a new numerical strategy which the authors refer to as the "Transport-based Mesh-free method (TMM)" and discuss its applications to mathematical finance. The proposed method enjoys good accuracy properties that are similar to those obtained with integration formulas based on Monte Carlo methodology, and in particular enjoys quantitative error bounds that have important implications in applications. The authors outline the main ideas behind this new strategy, which relies on techniques of transportation and reproducing kernels. It leads the authors to an efficient method for numerical simulations, while providing some light on the techniques currently developed by the artificial intelligence community. In the applications in the finance industry, their approach provides an accurate and fast algorithm, allowing the authors to compute various types of risk measures. Theoretical arguments are also put forward to justify the sharp convergence rates and almost optimal computational times that the authors observe in their numerical tests, and, in addition, typical cases arising in finance applications support their claims. The problem of the curse of dimensionality in finance is briefly discussed.

In "Comparing Option Pricing Methods in q," Deanna Morgan and Sergei Kucherenko use kdb+ and the q language to compare the use of Monte Carlo and Quasi-Monte Carlo methods for pricing options. Low-discrepancy Sobol' sequences are used to price European and Asian options, using both incremental discretization and Brownian-bridge construction. Results are compared to the deterministic Black–Scholes price for each option type. Analysis was carried out using the time-series database, kdb+, from Kx. Kdb+ is a hybrid on-disk and in-memory columnar database, optimized for the ingestion, storage, and analysis of huge amounts of structured data. Kx software is widely used in the financial industry, for streaming, real-time, and historical analysis of market data. Their code makes use of the efficient and concise nature of the q language, to mirror the results shown in Kucherenko and Shah (2007).

Enjoy!

TECHNICAL AUTHORS

Swap Rate à la Stock: Bermudan Swaptions Made Easy

Dariusz Gatarek is a graduate in applied mathematics from the Warsaw University of Technology. He spent 20 years in many financial and advisory institutions, such as BRE Bank, Société Générale, Glencore, UniCredit, Deloitte, and NumeriX, specializing in valuing derivatives and designing risk management systems. Currently, he is a Professor at the Polish Academy of Sciences. He has published a number of articles on financial modeling, and his paper "The Market Model of Interest Rate Dynamics" with Brace and Musiela is regarded as a classic. He is a frequent speaker at conferences worldwide.

Juliusz Jabłecki s the Director of Financial Risk Management Department at Narodowy Bank Polski. He graduated with a PhD in Economics from the University of Warsaw where he also teaches finance. Before joining the central bank, he worked as an economic capital expert for Pekao Bank SA (then part of Unicredit Group). He is a co-author of the book "Volatility as an Asset Class: Obvious Benefits and Hidden Risks", a contributor to *Risk* magazine, and author of numerous academic publications on monetary policy and quantitative finance. In his current role at NBP, he oversees strategic asset allocation for the central bank's FX reserves portfolio and is responsible for financial risk management underlying NBP's FX reserves as well as monetary policy and financial stability operations.

The Transport-based Mesh-free Method: A Short Review

Philippe G. LeFloch holds a permanent position at Sorbonne University, as a Research Professor of the Centre National de la Recherche Scientifique. He graduated from the Ecole Normale Supérieure (Saint-Cloud, France) and obtained a PhD in Mathematics in 1988 from the Ecole Polytechnique (Palaiseau, France). In 1995, he received a Faculty Early Career Development award from the National Science Foundation. He worked at the Courant Institute of Mathematical Sciences (New York) and the University of Southern California (Los Angeles). He has published more than 200 research papers, with about 100 different co-authors, and has written several textbooks, including the graduate course "Hyperbolic Systems of Conservation Laws", Birkhäuser (2002) and a monograph establishing the "Global nonlinear stability of Minkowski space for self-gravitating massive fields."

Jean-Marc Mercier is the head of the research and development team at MPG Partners, a consulting firm for the financial services industry. He graduated from the University of Bordeaux (France) with a PhD in Applied Mathematics, obtained in 1996. He started his career as an Academic researcher, then moved to engineering in the finance industry. He is now sharing his time between various challenging industrial problems which he tackles with fundamental research tools.

Comparing Option Pricing Methods in q

Deanna Morgan has an undergraduate degree in Astrophysics from the University of Edinburgh and has been working as a machine learning engineer at Kx for two years. During her time with Kx, she has worked alongside researchers at the NASA Frontier Development Lab and on the Core Machine Learning team, developing clustering algorithms and automated machine learning frameworks.

Sergei Kucherenko received his MSc degree and PhD in Applied Mathematical Physics from Moscow Engineering Physics Institute in Russia. He has held a number of research and faculty positions in various universities in Russia, the US, the UK, and Italy. He has also worked in investment banking. Currently, he holds the position of Senior Research Fellow at Imperial College London. He is also a founder of BRODA Ltd., which provides consultancy services to investment banks and financial companies in the area of Monte Carlo and Quasi-Monte Carlo simulation and other advanced numerical techniques used in quantitative finance.