QUANT DIGEST

THE INDUSTRY TODAY

Global Derivatives
Trading & Risk
Management

CONTENTS PAGE

WELCOME

Welcome to the very first edition of Quant Digest, a publication dedicated to the key trends and global challenges facing the derivatives, trading and risk management industry today. With Global Derivatives just around the corner, taking place on 9-13th May in Budapest, this magazine will set the context for the key discussions across the spectrum of modelling, computational and numerical efficiency, trading, risk management and so much more in the world of quant finance. Over the course of this issue we will delve into some of these key themes to provide a host of differing ideas and expertise on those industry trends that are shaping the future.

It is the significant depth and breadth of content that marks out Global Derivatives as a unique forum and it is our aim that this magazine will help to build on our quality, timely content made possible by our growing community.

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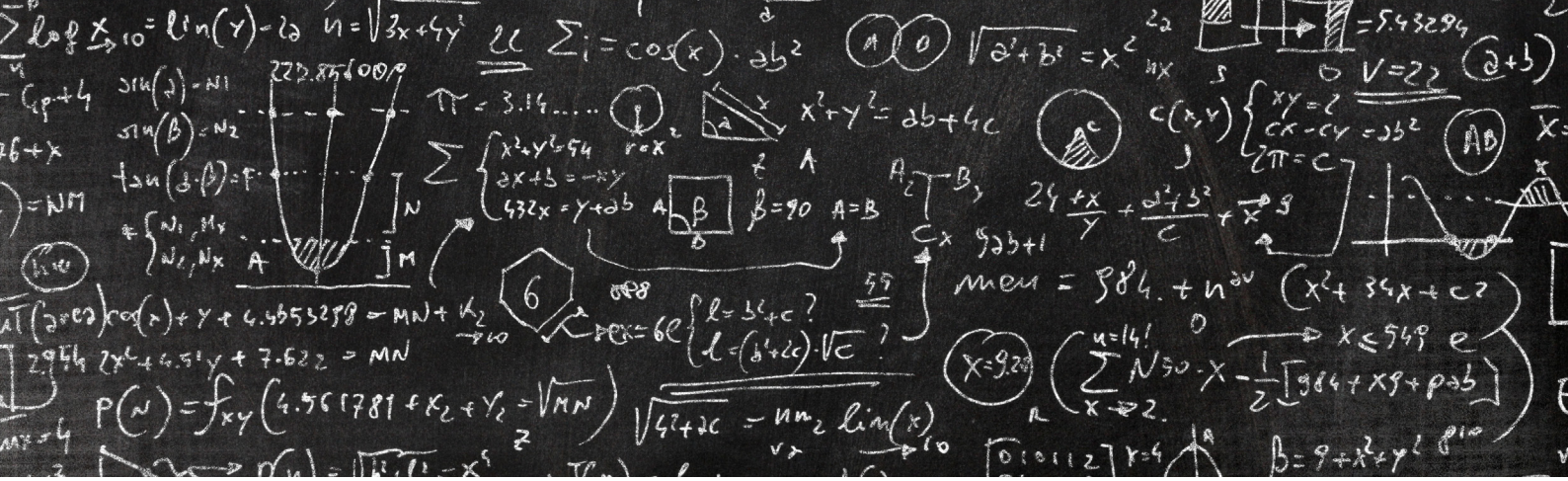


THE RISE OF ALGO TRADING

Lynn Strongin Dodds discovers the reasons behind the increase of algo trading and considers their place in the futures market.

Algorithms are now an integral part of the landscape and buy side firms are spoilt for choice. Volume weighted average price (VWAP) or the time-weighted average price (TWAP) are not the only options any more but they can chose from a menu of offerings. To date most of the action has taken place in the equities space, but increasingly attention has turned towards other asset classes. Although different in nature, the challenges for both are in implementing an effective strategy.

The trends are reflected in a recent Greyspark study which analysed the trading data from the largest interdealer brokers. It showed that that algos account for up to 60% to 70% of equity markets volumes while FX is expected to comprise around a third this year. Its growth has outstripped that of trading by phone, as well as on non-automated electronic platforms that still require human traders to process orders.

"Algo trading in equities has increased due to electronic trading and FIX API protocols and these same trends are applying to fixed income and other derivatives," says Anna Pajor, principal consultant at consultancy Greyspark. "The main drivers, as in equities, are the ability to source liquidity and to get the best price."

The move to electronic venues is being encouraged by regulations such as MiFID and the European Market Infrastructure Regulation, but Basel III's more stringent capital requirements is also seeing banks take a back step. They are increasingly acting as intermediaries by feeding client orders to trading platforms, without shouldering the risk themselves. Execution in FX is left to algos which continuously scan the market for the best rate available for each currency at any point of time. In return for giving clients access to their advanced trading software, banks charge a fixed fee.

Institutional investors are also becoming more demanding. Buy-side firms are looking at trading in a much more granular way and optimising their strategies," says Yuriy Shterk, head of derivatives product management for Fidessa in the US." As they become more comfortable in equities, we are seeing them being created for the FX and futures market.

Not surprisingly in this compressed margin environment, brokers have seized the opportunity to develop a broader range of algos and many have flooded the market with variations on a theme. However, developing algos for these asset classes presents its own set of challenges and the models in equities are not always easily transferrable. Shterk explains this is because derivatives reflect a broad range of underlying asset classes from fixed income through to FX and even physical commodities. Each of these has its own trading characteristics, with differing contract lengths and multi-legged strategies, so the 'one size fits all' approach that works for cash equities doesn't work for derivatives.

Looking more closely at FX, for example, shows that it is similar to equities because both are continuous two-sided quote-driven markets and the use of algos can help reduce market impact by breaking a larger order into several smaller pieces. This not only makes it more efficient from a price perspective but also enhances the ability to achieve better execution. Moreover, they share the hurdles of managing adverse selection through intelligent routing and order placement policies.

One of the biggest differences is in the fragmentation of the market. Although electronic trading is rising and now accounts for just over half of the spot market, there is still a great chunk of volume transacted in the traditional bi-lateral fashion. Many firms are loathe relinquishing the relationship because they tend to get better prices from their dealers and can exclude short term participants such as high frequency traders
By contrast, algos in the futures markets have proved more popular as regulators have made a big push in getting as many derivatives contracts as possible onto exchanges and through central clearing. As research from TABB Group points out futures are the perfect breeding ground for algos due to product diversity, margin efficiencies, and cross-market appeal.

The consultancy notes that greater demand for algos is a direct result of the market's growth, with more complex strategies and the need to automate processes prime factors driving adoption. For optimal results, firms must use automation to improve trading desk efficiencies, lower execution risks, and better compete with market participants already using and upgrading their advanced execution strategies.
According to Shterk, the sell-side has been responding by developing algos that extend beyond the classical VWAP and TWAP benchmark strategies. These include algos that mask order types so that trading intention and potential information leakage is minimised which offers much greater levels of sophistication, control and discretion. While automation algorithms are removing the need to manually monitor the market, there are also algos designed to track and hit newer and more relevant performance benchmarks, such as arrival price, or even dynamically updated trading goals.

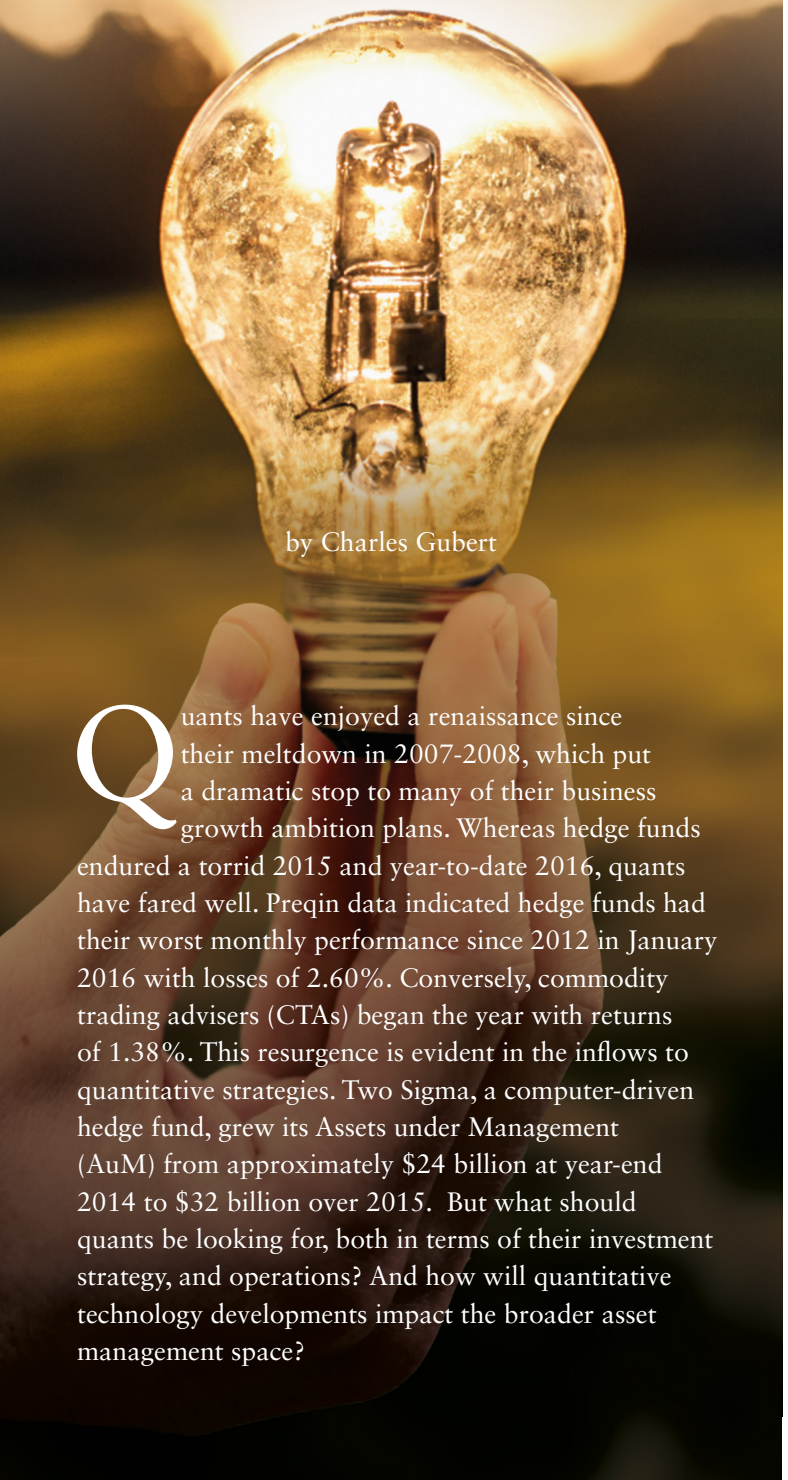
He adds that many firms also employ algos to manage the relationships between orders and trigger pre-defined responses when certain market conditions occur. These can eliminate the errors associated with trading multiple products across various regions whilst ensuring that a firm places its order at the right time and it is not rejected by the exchange

One of the biggest challenges is choosing the right broker and strategy. Buy-side firms are under greater pressure due to MiFID II to demonstrate their acumen in navigating the markets and proving they are hitting their best execution targets. Industry participants believe that one way firms can achieve greater transparency, control and execution is through integrating algos with central workflows and order management systems (OMS).
In addition, they will need to employ sophisticated analytics to evaluate the success of different brokers and their strategies.

"In many ways it is a question of size," says Rebecca Healey, Managing Partner at Incisus Capital Partners. "The larger players can collect the data required and create their own statistical dataset to demonstrate that their trading strategies are achieving best execution. This will be more difficult to do for the small to medium sized players who may have to use third party data providers."

TOP 10 NEW IDEAS AND QUANTITATIVE TECHNIQUES

IN STRATEGIC PORTFOLIO AND ASSET MANAGEMENT



by Charles Gubert

Quants have enjoyed a renaissance since their meltdown in 2007-2008, which put a dramatic stop to many of their business growth ambition plans. Whereas hedge funds endured a torrid 2015 and year-to-date 2016, quants have fared well. Preqin data indicated hedge funds had their worst monthly performance since 2012 in January 2016 with losses of 2.60%. Conversely, commodity trading advisers (CTAs) began the year with returns of 1.38%. This resurgence is evident in the inflows to quantitative strategies. Two Sigma, a computer-driven hedge fund, grew its Assets under Management (AuM) from approximately $24 billion at year-end 2014 to $32 billion over 2015. But what should quants be looking for, both in terms of their investment strategy, and operations? And how will quantitative technology developments impact the broader asset management space?

1 Reverse Engineering hedge fund strategies

Leading hedge funds tend to deliver alpha for clients and this is what justifies their higher fees. A growing number of quants are now analysing these hedge fund strategies and reverse engineering them in what could give investors exposure to replicate strategies at a far cheaper price. Merger arbitrage is one such example. Some quants have been analysing M&A data and applying mathematics, trend analysis and backdated testing, and incorporating it into their trading systems. Not everyone is convinced. Reliance on historical models and computer-driven strategies has been found wanting in the past, particularly during the crisis. Nonetheless, offering investors cheaper exposure to replicate strategies of successful hedge funds could prove attractive, particularly if the on-going debate around hedge fund fees shows no sign of dying down.

2 Environment, Social, Governance (ESG)

Adherence to ESG standards has been a prerequisite for fund managers looking to attract investors such as religious foundations or medical charities. Even some pension funds and sovereign wealth funds are insisting there be a degree of ESG in their managers' portfolios. It appears now that quants are beginning to embrace ESG albeit not entirely from a traditional ethical investing perspective. Integrating non-financial ESG data such as board composition, labour disputes and carbon emissions, for example, can be an early-stage indicator of company performance. This can give quants a competitive advantage. However, there are challenges insofar as the data can be subjective while not all companies will report on their ESG policies.

3 Artificial Intelligence (AI)

Computer-driven trading is not a new phenomenon. A select group of hedge funds are, however, developing technological infrastructure to support AI whereby trading software can adapt to market changes by itself negating human input altogether. Traditional computer-driven strategies are powered by algorithms which can mine huge swathes of data. These algorithms are usually created by experts in mathematics, science or engineering. AI software is developed by humans as well – however, AI will develop further through data and information processing through its own artificial cognitive abilities. The recent influx of technology experts from Silicon Valley into fund houses is testament that asset managers including quants are taking AI seriously.

4 Succession Planning

Despite all of the in-roads and advances in technology, having a quality succession plan is crucial for quants and asset managers more broadly to help guarantee longevity

in their businesses. An inability to plan for the future can stem innovation and result in investor flight if returns sour following the departure of a key person/personnel. Renaissance Technologies had a succession plan in train for a long time to deal with life after the departure of its eponymous founder. It is essential fund managers ensure they have quality successors to develop the business going forward.

5 Systems

Technology is evolving at a rate unseen by any generation. Continually updating software and systems, and testing them against all sorts of scenarios, particularly in today's market volatility is crucial. Investing in technology and avoiding situations where forward progress is hamstrung by legacy systems is essential. While innovation is key, it is important quants (and other asset managers) – which possess enormous amounts of proprietary and sensitive data – recognise threats to their systems. Cyber-crime perpetuated by nation states, criminal gangs or even disgruntled employees must be dealt with. A failure to take seriously cyber-threats can be fatal. A leak of proprietary data or hijacking of portfolio management systems are just two examples of the threats asset managers face. Investors and regulators want asset managers to have quality cyber-protection, and firms must be cognisant of that.

6 Transparency

One of the key challenges for quant funds has been their opaque, black-box nature. Fearful their proprietary secrets could be replicated or copied, many have elected to be as coy as possible with institutional clients when discussing the magic behind their investment prowess. This is changing, partly driven by an investor reluctance to allocate to overly secretive black box strategies in light of Madoff. A growing number of quant funds appear to be sharing with clients how they make their money along with broad descriptions around how their algorithms operate. This is likely to be a growing trend, particularly if quants want to attract more institutional capital.

7 Prime Brokers like Quants

Basel III's capital requirements have turned hedge funds into a balance sheet intensive activity for prime brokerage arms. As such, a number of prime brokers have exited smaller clients or those running strategies which are illiquid or leveraged as they cannot offer sufficient balance sheet to support them. Distressed debt, fixed income and credit managers have been the worst affected as prime brokers become more selective about the strategies they service. Quants, however, are a different story. Active systematic traders generate higher commissions on execution services for their prime brokers. With prime brokers retreating from certain hedge fund strategies, quants could be beneficiaries.

8 Regulation

Quants must be mindful that regulation will impact their businesses over the coming years. The Securities and Exchange Commission (SEC) is currently assessing whether to require unregistered trading firms to register as market makers. The Financial Industry Regulatory Authority (FINRA), an industry funded self-regulatory body, is scrutinising high-frequency traders' (HFTs) internal control mechanisms. Meanwhile, the Markets in Financial Instruments Directive II (MIFID II) could require algorithmic traders and HFTs to register with national competent authorities. This could entail regulatory reporting for algorithmic traders and HFTs subject to MIFID II. As such, quantitative strategies ought to factor the added costs of regulation into their businesses.

9 Data

Big data and data mining were the buzzwords of 2015. A number of service providers – many of whom harnessed huge swathes of data about fund managers' investment strategies and clients – sought to aggregate this information and enable firms to leverage the findings. A growing number of asset managers are harnessing the powers of big data gleaned from regulatory reports (of which there are now many – Annex IV, Form PF, European Market Infrastructure Regulation [EMIR] derivative reporting) to make structural adjustments and improvements to their businesses. Others (more retail-orientated asset managers) are mining social media such as Facebook to identify behavioural trends among pre-existing or prospective clients. By identifying these behavioural trends, fund managers can tailor products accordingly to the investors' risk profiles.

10 Robo-Advisers

Robo-advice has been a mainstay in asset management for some time. Robo-advice is simply when computer-driven algorithms provide investment advice. It is gaining popularity in wealth management as many consumers, particularly retail, appreciate that it is easy-to-use and available online. Given the changing investor demographics – i.e. younger, more tech-savvy, embracing such technologies is crucial for fund managers if they are to appeal to this new generation of savers. Nearly two-fifths of wealth managers believe robo-advice will boost their ability to gain traction among millennials, according to Vanguard. A number of asset managers including Blackrock, Schroders and Fidelity have acquired, entered into partnerships or purchased stakes in robo-advisory companies. The importance of robo-advice should be noted by asset managers.

WHAT CAN QUANTUM COMPUTING ACHIEVE FOR QUANTS?

An interview with Marcos López de Prado,
Senior Managing Director at Guggenheim Partners
by Barbara Mack.

In recent decades, there have been dramatic developments in a wide range of technologies. Of particular interest to quants are the new capabilities made possible by high performance computing (HPC), combined with advances in artificial intelligence, data analytics, and machine learning. Concrete evidence of the state of AI today includes IBM's Deep Blue, which beat Grandmaster Garry Kasparov at chess in 1996, IBM's Watson, which won the game show Jeopardy in 2011, and Google's Deep Mind Alpha Go, a computer that won the ancient, highly complex game Go, beating the European Champion Fan Hui in 2015.

In supercomputing hardware news, there have been major breakthroughs in quantum computing over the past fifteen years and in December 2015, NASA demonstrated the power of a $15-million quantum computer (manufactured by D-Wave) at the Quantum Artificial Intelligence Laboratory in the Ames Research Center in California. We had a chance to sit down with Marcos López de Prado of Guggenheim Partners and the Lawrence Berkeley National Lab to discuss the current state of affairs in HPC and quantitative finance.

How did you arrive at this intersection of quant finance and HPC?

Like most people, I started with the foundations of financial theory and econometrics by reading literature on asset pricing, portfolio construction, risk management, and the prediction of variables using standard methods from Nobel Prize winning researchers. After a number of years, I realized that most of these theories and models didn't work in practice, and if I expected to beat my peers and outperform the market, I would have to discover something myself. I noticed that most people use rudimentary techniques, sometimes drawing on research from the top journals, but basically these methods are refinements to regression models invented decades and centuries ago. The math in those papers involves linear algebra, simple calculus, and maybe some inferential probability, all pretty basic stuff, and yet they are using it to attempt to explain extremely complex, modern financial systems. I was sceptical about the possibility of encapsulating the global markets with such primitive tools and models. So I decided that I would have to learn new ways to approach the challenge myself, so I started working with scientists – physicists, mathematicians and others at national labs who study computational biology, image recognition, machine learning, and experimental math. From there I developed an approach that focuses on the five aspects I found personally helpful to beat the market:

Unique data: Work with data that no one else has or that no one else can model because it is inaccessible (e.g. the data points are public but scattered, and no one has pulled them together.) Special challenges lie in vast amounts of unstructured, asynchronous, hierarchical data that is extremely difficult to model.

Advanced techniques: Apply complex math or create new math so you can employ techniques that no one else is using. The models that you develop must be nuanced enough to capture the essence of the market. Advanced methods include graph theory, combinatorial mathematics, integer optimization, Bayesian networks, algorithm complexity, machine learning, and the frontiers continue to grow.

In recent decades, there have been dramatic developments in a wide range of technologies. Of particular interest to quants are the new capabilities made possible by high performance computing (HPC), combined with advances in artificial intelligence, data analytics, and machine learning.

Image: IBM's Deep Blue beat Grandmaster Garry Kasparov at chess in 1996

Image Source: rue89.nouvelobs.com

Hard problems: The problem is most interesting if it is considered unsolvable or intractable; if others have not solved it yet, then there is room for outperformance. If it has already been solved, then you will wind up sharing the profits. Therefore, you have to focus on NP-Hard problems.

Technological advantage: Use machines that no one else has – either by building your own high performance computing cluster, or by gaining access to a quantum computer.

Meta-Strategies: You can learn about the markets in the same way that people learn in physics labs. It is important to treat the work as if you are in an experimental lab, and you are using a research protocol that accommodates the particularities of financial research. Then your knowledge will be acquired through direct experimentation with the market, interacting with other investors, and not just from a series of biased statistical tests (a flaw in many papers on finance).

This combination, the five legs, is very powerful and will give you a substantial edge, but there are no magic bullets. You need special (non-commercial) data that will make a difference, even if you do have a truly brilliant method or the most advanced and expensive machine.

What is quantum computing and how is it different from more established forms of high performance computing?

Engaging with high performance computing is like running on a treadmill - you have to keep running in order to preserve your position. With hardware, it is relatively easy to acquire an edge – that is a matter of budget. You should have an interesting task though and then there is the question of software – if you are not using the machine in a smart way, you are wasting your money. Further, you need to be recycling the investment all the time – parallelizing, hyper-threading, tweaking the infrastructure – this takes a lot of engineering time and effort.

Quantum computers turn the problem on its head. For the kinds of clusters that reside at the Lawrence Berkley National Lab, we are using math to solve physics problems, with the help of finely tuned, parallelized machines. But with quantum computers, you can use physics to solve math problems. It is a revolutionary paradigm (literally, a quantum leap!) that forces you to rethink how the problems are articulated. The work of the mathematician becomes an exercise in translating a problem in a way that Nature can solve it – it is like asking the universe to give you the answer to a well-posed question. This is the beginning of a new Era, and it will change the job of the mathematician and computer scientist in the years to come.

How will quantum computing evolve in the near-term?

We are still in the early days for quantum computing – it is beginning to show its potential and this has happened earlier than many people predicted. Some people thought the approaches would never work, and then last year appeared tangible evidence that quantum

computers were solving intractable problems – the team at NASA Google's Quantum Artificial Intelligence Lab had impressive results, which they announced last December. I was part of a team of researchers that also presented evidence that D-Wave's quantum annealer is able to solve an NP-Complete problem that is relevant to all asset managers: General multi-horizon portfolio optimization.

Several paradigms are emerging and competing for attention. The two most promising are the "quantum annealing" and the "gates" approaches. As happens often in Academia, these approaches are quite antagonistic at the moment. The quantum annealing approach seems to be more practical in the near term, but eventually both should work. You have to ask, why would you only choose one language for coding? You can use C or C++, Python, or Java; some languages are better suited for certain problems than others. The same is true of quantum computing – there is no need to choose a particular paradigm – it is more realistic to expect to use different devices for different tasks.

What does quantum computing mean for the future of quantitative finance?

There is a movement within mathematics today that takes the following approach: for some problems, we cannot wait for formal proofs to make progress. An example would be Fermat's Last Theorem; it can be stated in a way that a high school student can understand it, but it has not been easy to crack. It was first conjectured in 1637 and was finally proven by the British mathematician Sir Andrew Wiles 358 years later, in 1994-5.

We cannot wait for airtight proofs to critical questions, so we must work with conjectures, which are identified computationally. This brings us to a realm of mathematical research by experiment, which quantum computing greatly facilitates. As it relates to finance, quantum computing will help us approach complex, NP-Hard problems, in new ways. Most researchers model returns as iid normal. Throw in some stochastic process, like GBM, assume the continuity and derivability of prices – these are simplistic methods that lead to unrealistic closed form algebraic solutions.

With new tools and techniques, the very notion of a closed form solution will change.

In the future, we will consider algorithmic solutions as closed form, where the solution can be achieved within a known number of steps. Imagine a machine that can produce results within bounded computational time that are as accurate as an unknown algebraic solution (which may take centuries to derive). This is a role that quantum computing will play – we will no longer have to simplify or dumb down the problem. We can feed a mathematical problem to a quantum computer with all its real world complexity, and let the laws of Physics solve it, just as the universe solves the problem of the planetary orbits and the movement of the galaxies itself, instantaneously, in real-time, for free.

Some of the most successful hedge funds in history are math-driven. They are the product of the second quant revolution, which combines big data, machine learning, HPC, and quant meta-strategies. With advances in quantum computing, many new possibilities will open up in the field of quantitative finance in the years to come.

Biography

Marcos López de Prado is Senior Managing Director at Guggenheim Partners, where he manages several multibillion-dollar internal funds. He is also a Research Fellow at Lawrence Berkeley National Laboratory's Computational Research Division (U.S. Department of Energy's Office of Science), where he conducts unclassified research in the mathematics of large-scale financial problems and supercomputing.

In addition to his 18 years of trading and investment management experience at some of the largest corporations, he has received several academic appointments, including Postdoctoral Research Fellow of RCC at Harvard University and Visiting Scientist at Cornell University's Operations Research Department. Marcos earned a Ph.D. in Financial Economics (2003), a second Ph.D. in Mathematical Finance (2011) from Complutense University, is a recipient of the National Award for Academic Excellence by the Government of Spain (National Valedictorian, 1998) among other awards, and was admitted into American Mensa with a perfect test score.

Marcos serves on the Editorial Board of the Journal of Portfolio Management (IIJ), the Journal of Investment Strategies (Risk) and the Big Data & Innovative Financial Technologies Research Series (SSRN). He has collaborated with over 30 leading academics, resulting in some of the most read papers in Finance (SSRN), multiple international patent applications on Algorithmic Trading, three textbooks, numerous publications in the top Mathematical Finance journals, etc. Marcos has an Erdös #2 and an Einstein #4 according to the American Mathematical Society.

THE LAST CHAPTER OF THE FRTB

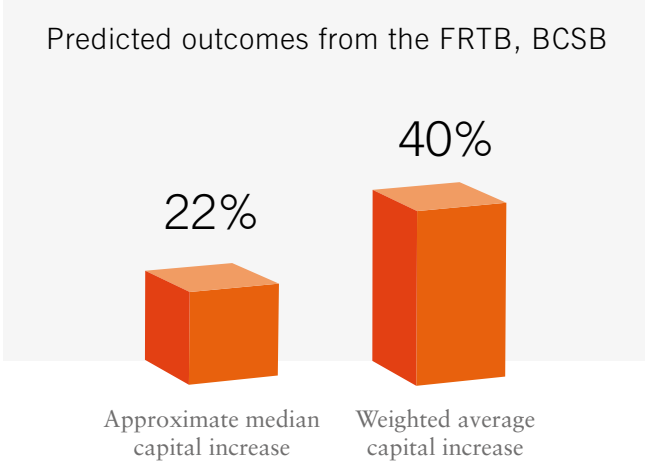
As the Basel Committee on Banking Supervision (BCBS) kicked off the year with the long-awaited revised standards for minimum capital requirements for market risk, Lynn Strongin Dodds looks at what that means for you.

While perceived as the last chapter of the Fundamental Review of the Trading Book (FRTB), for many banks the work has just begun in terms in terms of reviewing their operational processes and restructuring trading desks.

As with many other pieces of post financial crisis legislation, the FRTB was controversial but broke records in the time it took to negotiate. The final version was hammered out after three rounds of consultations, four quantitative impact studies and around five years of heated discussions. The aim is to harmonise the treatment of market risk across national jurisdictions and to address the dangers that almost toppled many in the banking industry. These include inadequate capital held against market risk and the independence of determining which assets and products can be placed in the trading book.

The BCSB estimates that the rules are likely to lead to an approximate median capital increase of 22% and a weighted average capital increase of 40% compared with the current framework.

Predicted outcomes from the FRTB, BCSB



That is lower than what previous assessments have indicated. The October 2015 analysis by three industry groups showed an increase weighted average capital by 4.2 times.

According to Sven Ludwig, Managing Director & Head of SME Risk Management and Analytics, EMEA, at FIS (formerly SunGard), there are three main building blocks - the trading book/bank book boundary; the standardised model and the internal model approaches. On the first point, the final framework imposes stringent rules for internal transfers between trading and baking books plus introduces a presumptive list of assets that should be placed in the trading book unless a justifiable reason exists not to do so.

This is intended to limit an institution's ability to move illiquid assets from its trading book where they must be marked to market to its banking book to avoid higher capital charges. One of the main criticisms about the old trading book/banking book boundaries was that the previous definition led to insufficient capital being held against the risk that the banks were running. In essence, firms were effectively encouraged to push non-performing trading book holdings to the banking book, thereby reducing the amount of required capital cover by 80%.

As for standardised approaches, the revisions are in line with the general push away from internal based models. The new standardised regime though will be more risk sensitive and will be based on a bank's pricing models to capture more detailed and complex risk factors across different asset classes. A report by PWC shows that it is likely to result in higher capital charges for certain businesses due to inclusion of residual and basis risks that are not captured by the previous Basel II rules.

The charges are likely to be more onerous on banks using their internal models. "It is clear that regulators want financial institutions to move towards the more standardised approach," says Richard Bennett, head of Regulatory Reporting, EMEA for Wolters Kluwer." It will become more complicated to use internal models. Banks will have to switch from using value at risk measurements to expected shortfall plus include liquidity horizons and non-modellable risk factors."

Drilling down deeper, the introduction of liquidity horizons will be used to reflect the period of time to sell or hedge a given position during a period of stress. More liquid products such as equity products are given a smaller window of around 10 days while less liquid products such as structured credit products are given a greater timeframe of around 250 days. As for non-modellable risk factors, only those risks that meet strict data availability and quality are considered as modellable. All other risks must be accounted for by a catch all capital charge which is calculated for each one based on a risk specific stress scenario.

Moreover, banks will have to prove the mettle of their internal models through back testing and P&L attribution assessments using daily model results on a desk by desk instead of portfolio level. Failure to meet the validation criteria that is implemented will mean the desk has to revert back to using the standardised approach for a minimum of 12 months.

The result is that banks relying on their in-house computations will suffer higher charges. A study by the Basel Committee shows that the capital requirements will be roughly 40% higher in the internal model versus the standardised approach.

Breaking it down per risk component, the additional capital ranges from about 20% for credit spread, non-securitisations and foreign exchange risks to about 50% for equity risk.

Against this backdrop, it is not surprising that banks will re-evaluate the trading of riskier assets. As. Daniel Mayer a manager in Deloitte's risk advisory business put it, "There is no differentiation between OTC and other products, but as these instruments are likely to contain more risk factors, they will result in higher capital charges. It is in the nature of the asset class."

Ludwig agrees, adding, "The liquidity horizons define your capital so the broader more complex products will be on longer timeframes. The question banks will have to ask is how they structure their trades and the capital impact. The internal models will impact their capital and the result could be an adjustment to trading in the derivatives space."

Although different banks will have varying requirements, industry participants are encouraging institutions to start their engines now. The larger players are ahead of the curve but smaller and mid-sized players are lagging behind. Systems need to be overhauled and positions examined while data as with many new regulations will be key to meet the internal and external reporting requirements. This is especially true for banks using both internal and external models. They will not only have to report risk capital under both approaches but also the key modelling assumptions in order to help them better understand the differences between the variations between the two.

Capital requirements, Basel Committee

increase of capital requirements in the internal model versus the standardised approach

capital for credit spread, non-securitisations and foreign exchange risks

capital for equity risk

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MODEL DEVELOPMENTS IN DERIVATIVES: A BRIEF RETROSPECTIVE

Tracking the journey of modelling and examining the key developments, strength and weaknesses of models from volatility modelling to equity and interest rate models, with Barbara Mack.

Models are artefacts from the art and science of creating abstract representations based on real world phenomena. There is a vast treasure trove of models developed throughout the history of modern finance. Some have worked well over time and others have come to exhibit substantial flaws, even to the point of contributing to extreme market events. From basic principles of discovering value grounded in real financial data to more abstract notions such as the random walk of prices, asset managers are always seeking the best way to maximize returns. Some are willing to bear a fair amount of risk and some are not, but long or short, hedged or unhedged, diversified or concentrated, models of one form or another guide the decisions of most major market participants today.

In a recent blog for FINCAD, "Models and Measures," John Hull and Alan White observe, "Traditionally quants have been concerned with the processes followed by market variables in a risk-neutral world. This is because their main focus has been on the valuation of derivatives…But it should always be remembered that a risk-neutral world is nothing more than an artificial construct. It does not describe how market variables behave in the real world, the world we actually live in."[1]

This clear awareness of the gulf between the world of idealized, finely-tuned models is noted by quant eminence Emanuel Derman as well. "No model can be correct – a model is not a theory – and no replication is truly accurate. But models can be immensely helpful in calculating initial estimates of value."[2] So let's look at how value has been estimated across several asset classes and contexts.

Equities: a story of value

The basic expectations on a stock price for a given company are shaped by an investor's worldview and preference for the framework of fundamental analysis, technical analysis, or quantitative analysis. The financial advances of the last few decades introduced the Efficient Market Hypothesis, the Capital Asset Pricing Model, and Modern Portfolio Theory, emphasize the risk-reward tradeoff, and have influenced generations of investors. Metrics for calibrating the expectation of future rewards (performance) evolved from the bottom-up search for intrinsic value based on the company's balance sheet and income statement to incorporate an array of financial ratios and comparative measures. Additional enhancements to equity valuation models have included ways to predict capital appreciation through growth and dividend-based models.

An alternative to the fundamental view arose in the quant community, which eschewed rumination over the particularities of a company's financial statements, and instead viewed stock prices as a random walk. Staking their bets on the principle of Geometric Brownian Motion, quants created binomial trees and other probabilistic methods of pricing stocks. Their methods lent themselves well to the development of the options and futures markets and supported a range of strategies employed by hedge funds, signalling a radical departure from traditional long-only investing.
In terms of single stock research, the playing field has not changed too radically. However, as technology has progressed and both mass media and social media generate tremendous volumes of information that can be compiled and analysed, machine learning and data-driven models offer new possibilities for equities markets and stock pricing models.

Bonds: whither the rates?

At first glance, the components that make up a bond may seem rather simple. You have an instrument that is offered at par, pays interest over a certain period of time on a specific schedule, and is redeemed at par. However, the situation is quickly complicated by a number of structural factors and price dynamics. First, we have the variability of interest rates, choices regarding duration, and the ability to buy or sell the bonds before maturity. In the case of Treasuries, there are on-the-run and off-the-run issues, and introduction of even newer issues will impact the pricing of the latter. There are ways to plot yield curves, analyse convexity, and calculate the risk of default. Convertible bonds have embedded options and contingent convertible bonds offer the buyer the opportunity to convert to equity if a specific trigger event takes place.

In the current market environment, there are many questions about bonds. When interest rates are near zero, what are the implications of using Treasuries as a proxy for the risk-free rate? Is it reasonable to assume that government bonds are truly risk free, even stretching far into the future? As of 2015-2016, Europe and Japan have adopted negative interest rates; if other regions go down the same path what will happen to yields, the bond markets, and financial stability in general then?[3]

Options on options

As a touchstone for financial models, Black Scholes Merton 1973 is an excellent example of a concept that made its way to Wall Street from the ivory towers of academia.[4] Black Scholes captured the essential elements well, but it was some distance from market realities. However, change was in the air, and as options and futures exchanges emerged, new products were launched, and the derivatives market took off. Models too, proliferated; one large compendium of option pricing formulas offers insight into the vast array of approaches that were available by the mid-2000s, some more practical than others, of course.[5] It is also worth noting that the inaugural ICBI Global Derivatives Conference took place in 1994 and has witnessed dramatic changes in models and markets since then.

The spectre of volatility: threats and opportunities

"There is no free lunch," we are often reminded by financial practitioners and academics alike. One enduring feature of the modelling landscape is the quest for superior returns without taking on excessive risk. For those who have an appetite for risk, uncertainty, fear, and high volatility environments can be rewarding, but to quote another time-honoured catch phrase, "The markets can remain irrational longer than you can remain solvent."[6]

In the famous Black Scholes equation, volatility is depicted as a constant; you may choose the expected value, but it will sit static in the equation. However, as markets rise and fall, it is clear that volatility is not constant at all and modelling its stochastic nature accurately could boost performance. While stochastic volatility, volatility smiles, skews, and hedging approaches to tame the effects of vol have received significant attention in recent decades, there is still a Holy Grail aspect to the work.

Risk management

As regulators have sought to exert control over the wilder aspects of the derivatives world, they have also been challenged by the essence of the models. Post-crisis initiatives have focused on developing suitable risk metrics and reporting protocols in addition to prohibitions against proprietary trading and the imposition of capital requirements. Debates over the shortcomings of approaches to risk measurement and management have spawned variants: Value-at-Risk, C-VAR, and Extreme Value Theory, for example. Both the Comprehensive Capital Analysis and Review (CCAR) framework in the United States and Basel III in Europe have hammered on themes of capital adequacy, stress testing, market liquidity risk, and even more broadly, systemic risk. A new culture is growing up around the CVA, XVA, FVA, and MVA regimes and although quants may not find the most exciting challenges in such activities, model validation, risk management, and compliance have been hot areas for hiring.

While the awkward dance between regulators and the largest banks will continue for some time, one might ask if it is possible to build a better mousetrap. Former trader and current risk manager at AQR, Aaron Brown believes that there is a better way, calling on those responsible for risk management efforts to apply a set of basic principles to their processes, including defining a clear set of predictions, estimating a range of outcomes and observing breaks carefully, validating estimates with great rigor, and analysing data both inside and outside of the expected range, aided by sound judgment and imagination. [7]

Conclusion

Returning to one of the main principles of quantitative finance, Emanuel Derman observed, "The perfect axiom or model doesn't exist, so we have to use imperfect ones intelligently. Smart traders know that you have to combine quantitative models with heuristics."[8] His understanding is echoed in a long philosophical view of the markets put forward by economic sociologist Donald MacKenzie: "Markets, like technologies, are surely means – to be tinkered with, modified, redesigned, improved, and on occasion delimited – not ends that can only be embraced or be rejected. They are not forces of nature, but human creations. More fruitful conversations about them, involving a far wider range of participants than currently, are much to be desired…in a world of vested interests and huge inequalities the forces constraining those conversations are strong, but that is no reason to avoid seeking to embark on them."[9] Certainly there will be no shortage of conversations about the strengths, weaknesses, and future of models at Global Derivatives this year.

Reference:

1."Models and Measures 2," by John Hull and Alan White, University of Toronto, for FINCAD, http://www.fincad.com/blog/models-and-measures-2. See also their preceding blog, http://www.fincad.com/blog/models-and-measures-1.

2. Models. Behaving. Badly.: Why Confusing Illusion with Reality Can Lead to Disaster on Wall Street and in Life, By Emanuel Derman (Free Press: NY, 2011), p. 195.

3."Negative Interest Rates in Europe: A Glance at their Causes and Implications," The World Bank, Global Economic Prospects, June 2015, http://www.worldbank.org/content/dam/Worldbank/GEP/GEP2015b/Global-Economic-Prospects-June-2015-Negative-interest-rates.pdf.

4.Although it is popularly regarded as the first option-pricing model, in fact Ed Thorp was working with a similar model in the late 1960s; he merely chose not to publicize it, as it was deployed in his hedge fund.

5.The Complete Guide to Option Pricing Formulas¬, 2nd edition, by Espen Gaarder Haug (McGraw Hill, Inc.: NY, 2007).

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7.Red-Blooded Risk: The Secret History of Wall Street, by Aaron Brown (Wiley: NY, 2012), p. 342-3.

8.Models. Behaving. Badly.: Why Confusing Illusion with Reality Can Lead to Disaster on Wall Street and in Life, by Emanuel Derman (Free Press: NY, 2011), p. 197.

9.An Engine Not a Camera: How Financial Models Shape Markets, by Donald MacKenzie (The MIT Press: Cambridge, 2006), p. 275

THE RISING STARS

Looking into the future of quant finance in both banks and buy-side firms through the perspective of budding young quants, Guillaume Sall and Patrik Karlsson.

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PATRIK KARLSSON

In the "Golden Age of Quants" pricing of exotics derivatives was the hottest area, but as the financial crisis struck, and the aftermath emerged, everything changed. At large it seemed that quant activities had to take a back seat due to the dry up of exotics, but as valuation adjustments (XVA) had to be priced in, vanilla derivatives became the new exotics and new challenges emerged.

Today there are opportunities for quants to face more challenges outside the classic area of pricing. Hedging is more complex and need to be tackled from different angles as XVA need to be incorporated. To allow for efficient XVA hedging, a more liquid credit default swaps market is required. And with less exotics and more standardized products the flow desks will continue to grow. In addition, increasing derivatives clearing will require liquidity optimization. Collateralisation has recently been priced in, and without standardization it is open for enhancement. Smart derivatives with block-chain and automated systems for peer-to-peer collateral payments might be the game changer. Relying on technology behind crypto currencies such as Bitcoin, it has the potential to retire the XVAs for good.

The demand for quants possessing high level of IT skills is larger today. Quants have moved from analytics to more development roles, where skills to develop production libraries are essential. As trading becoming more automated quants have already explored algorithmic trading, replacing old-school traders, moving from sell-side, to buy-side and Fintech companies. Banks need to be aware of the increasing competition from Fintech companies, not just in terms of service but also employers as they are attracting the new generation of quants. We have gone from a less model driven period into a more (big) data driven one. And with big data new challenges emerge, one does not only need to be able use and process them fast, but also take advantage of having access to large data sets. We need to explore artificial intelligence (AI) in a broad business scope, to make sense of the data to improve trading and develop new business opportunities. We need to bring these advantages to our clients by implementing Facebook like services, such as being able to tailor investments based on client behaviours. And with the Internet of Things (IoT) we can take it further as the removal of the humans and better real-time big data techniques evolves. To allow fast data access and be able to analyse large sets of data in real-time will further increase the pressure on the IT infrastructure.

The industry spent the last years exploring GPUs and FPGAs to accelerate trading activities. The next big thing, quantum computing, still in the infant stage, will take computing power to a new level and will in the 2030s be as commons as CPU-GPU computing today. But as Moore's law is diminishing we also have to focus on writing smarter algorithms rather than adding new CPU-GPUs each time performance issues arise. Recently Google's AlphaGo became the first algorithm to beat a professional human Go player. Instead of relying on brute force methods, it relies on neural networks inspired by the human brain, to develop intuition and strategies rather than pattern recognition. However, as the area of AI increases one need to be aware of its potential operational risk. It only takes one mistake to wipe out an entire business, therefore sophisticated risk-management systems are essential.

As the definition of the traditional quant is emerging, there will still be pricing involved. Quants have over the last years explored, and are still exploring, innovative modelling, e.g., methodologies to efficiently estimate XVA. Something that previously worked well on a desk level does certainly not hold on an aggregated level. And with all new regulations waiting around the corner, the story is different. We need to have a generalised pricing approach that can be applied uniformly across asset classes and can adapt as the regulations and policies develops.

Although the "Golden Age of Quants", in which quants had the exotic trading desk as their clients is over, quants have moved to a situation where everybody needs them. Quants need to be more than ever aware of the new regulationsand policies, and how it impacts daily business. The modern quant need to be predictive, understand the big picture, seek business opportunities and will have more client facing roles in the future. Instead of being notorious rocket scientists there is an increased demand for quants to possess a broader range of skills, covering mathematics, finance, computer science and business administration.

Quants will therefore evolve into a universal solider and become more valuable as we enter the "New Golden Age of Quants".

GUILLAUME SALL

How has the quant role changed?

The excitement of quantitative research and the expansion of scientific literature about financial models from the 2000s have declined, hence dramatic changes in the job. For now and probably the next years to come, quant roles are and will be increasingly related to risk modelling and supporting trading activity. There is less research about new models or new derivatives. Banks are strangled by the latest regulations like XVAs and FRTB, which were put in place following the great financial crisis, and they were forced to change the focus of their activities. This restructuring is pushing quants to develop new risk indices and towards a more sophisticated management of risks which wasn't the daily job few years ago.

What are the most important factors that are changing the role?

Another activity that is developing throughout banks is the automation of systems. One example that highlights the power of mixing mathematics and computer science is automatic differentiation (the way to compute the derivative of a function with a set of computer techniques). At a time when the evaluation of risks is becoming more complex, the key issue is that of time computation becoming a very long process. Automatic differentiation is a perfect way to gain better performance of time computation. Another example of how useful computer science is is parallelism. I am thinking of the development of the use of GPUs; at a more distant forecast of FPGAs (very low consumption and very powerful) and maybe quantum computer, which require knowledge of hardware architecture.

What trends do you see in quantitative finance?

No one should be surprised if I say that the current excitement within quantitative research is around data science. We are in the midst of a global shift and the implementation of this technology is happening everywhere. I think that this will be a good trend to catch for young quants and will last several years. Requiring various skills including statistics and machine learning/deep learning, as well as computer science skills as a consequence of massive data sets needing attention, memory management is an imperative. The growth of internet modified the way that we treat information; the development of social networks accelerated the spread of mass communication and constitutes a pool of knowledge. But the extraction of this information requires a lot of IT skills.

There are growing numbers of hedge funds that base their strategies and arbitrage detections from information extraction of massive data archives. With the development of high frequency trading in funds, a new type of quant appears on the market. The central issue of high frequency activity is the speed of response and information detection on markets. Those who are specialised in signal analysis and telecommunication have become very trendy. The war waged by funds is a technological race.
The issues are different from what a standard quant in banks encounter, like the placing of computer servers as close as possible of the stock exchanges or the use of microwaves instead of optical fibres. Nowadays there is a continual need for rapidity and telecommunication skills.

What is the future of quant finance?

I think it is very difficult to reliably predict the future of quant finance or how it is going to evolve in the next years. The profession is in constant development and is changing rapidly with each passing year, forever impacted by financial crisis and the current economic situation.

I think the future quant should be more and more versatile. As Abraham Lincoln said, "things may come to those who wait, but only the things left by those who hustle."