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Can machine learning tools improve portfolio risk management...?

By James Williams

In a recent report on data analytics, *Hedgeweek* explored how sophisticated technology tools are being deployed by fund administrators like SEI to enhance the investor experience as well as within the front-office of fund management groups to improve portfolio and risk management.

In that report, Tobias True, Partner and member of the Portfolio Construction Committee at Adams Street Partners, a leading private equity group, explained that as the world continues to evolve around the use of data and the ability to map out different relationships, it has led to an evolution of the process in terms of how Adams Street uses data to gather insights and come up with hypotheses.

As True remarked in that report: “It has helped us enhance our ability to manage risk in our portfolios and to construct different portfolios. Data analytics has been a critical supplement to our bottom-up research by helping us construct top-down portfolios.

“If we have a portfolio with too much exposure to an industry or source of risk, we can’t just go out and rebalance it tomorrow like we could in the public markets. We therefore use data to think one or two steps ahead to help us (optimise) the way we allocate capital.”

Such is the volume of data at hand, it is allowing investment teams – hedge or PE – to use data analytic tools and machine learning applications to better understand...
the sources of risk and return, and derive fresh insights into what they think will drive performance.

In this respect, machine learning technology, which has really risen to prominence in the last five years, could help risk teams operate in a more integrated fashion with portfolio managers, and in effect push risk management further into the front-office.

“In the old world, risk management was done as a separate exercise by an independent department stressing portfolios and so on,” says Andrew Downes, COO of New York-based Atreaus Capital LP, a discretionary global macro hedge fund.

“With greater and more sophisticated data collection and faster, more powerful computing power and more real-time analytics, that segregation is less pronounced. It means if you are looking at risk analytics you can apply them to influence the investment process, making risk management less of a backward-looking exercise and more part of the portfolio investment programme.”

To illustrate how much artificial intelligence and machine learning is being used within the hedge fund community, a recent poll by industry data firm BarclayHedge found that 56 per cent of respondents confirmed they were using these tools in their investment process. More specifically, 33 per cent of respondents said they were using machine learning for risk management activities.

BlackRock has developed a unique operating system for investment managers called the Aladdin Risk Platform. The platform uses machine learning algorithms to provide users with risk analytics to monitor risk in their portfolios and can, according to BlackRock, automatically screen over 2,000 risk factors per day.

Massive computing and analytic power, whatever the machine learning application, have the ability to offer significant benefits to risk managers because the more the machines learn from the data sets, over time, the better they get at pattern recognition. Risk is becoming even more active than before because people have the tools at hand to run more detailed scenario models, at the pre-trade level, to see what affect a particular trade or set of trades might have on the VaR.

“If you are looking at risk analytics you can apply them to influence the investment process, making risk management less of a backward-looking exercise and more part of the portfolio investment programme.”

Andrew Downes, Atreaus Capital

Downes believes that if one wants to make risk management implicit in the investment process it is necessary to perform risk analysis at the time a trade is being placed.

“A simple version of this is to have real-time pre-trade checking versus risk parameters: the system can see if the trade about to be put on will keep the portfolio within the risk rules or exceed them, in which case it would therefore modify the trade going through or generate an alert.

“A more sophisticated version would be to enter trades or exit trades based on market conditions, probabilities of loss and size of loss. If you are holistically looking to improve performance by reducing losses, then your analysis tool would solve for that. However, the difficulty for machine learning tools – actually machines in general - is to identify the regime change or paradigm change in the markets, which is something that humans are particularly good at,” says Downes.

We are still very much skimming the edge of what could be possible in years to come, as machine intelligence grows exponentially and the machines themselves reach a singularity point: a tipping point, at which time machine intelligence exceeds the limits of human intelligence. Quite how we will think about monitoring risk in 10 years’ time is anyone’s guess. Will a form of augmented intelligence in the front-office control risk management on our behalf because it knows better?

For now, fund managers are well placed to use the analytic power of the machines to support their decision making.
A report by Chartis estimates the annual spend by hedge funds on risk, analytics and trading technology to be approximately USD9 billion, with a particular focus of that technology spend on modelling, portfolio management and analytics, and risk data aggregation and reporting.

George Kaye is the founder and CEO of Derivitec, a risk analytics software vendor. The firm’s central philosophy, according to Kaye, is to make it as easy as possible for people in the financial industry to provide validated risk management reporting: "That includes everyone from small hedge funds to global sell-side institutions," he says.

In his view there have been "seminal changes" in technology over the last five years which have radically transformed the way that people do business. "From our point of view at Derivitec, the most important change has been the cloud. The cloud is now so prevalent that it almost ceases to be a topic of conversation. There is so much happening with cloud technology. For example, the speed at which we can compute, the volume at which we can compute, the security of how we compute."

"That means things like large-scale risk calculations now happen in timescales that would have been unthinkable a few years ago," comments Kaye.

**Risk analysis creates virtuous cycles**

Better, faster, more powerful processing capabilities are the engine behind machine learning tools. Machines have become a good decision-making tool for portfolio managers to road test strategies, validate them and stress test them but it is still early days to expect the machines to provide predictive diagnostics on market risks. They are still in the second innings of self-supervised learning.

Risk analytics can offer tremendous value and insight for real-time risk management, but the human still has to exercise caution that false flags are not being created; after all, every algorithm is susceptible to bugs and glitches in code.

Kaye says that the greater processing power is helping firms like Derivitec to deliver even more granular, detailed risk reporting: "Absolutely. It’s all about granularity. We can run VaR calculations back 10 years on portfolios of thousands of trades with varying degrees of complexity on the trades. It doesn’t matter if the client is a small fund trading 20 instruments or a large fund trading 10,000 instruments, we have that elastic capability built in to our system. If we want to slice and dice the risk and look at it in all different ways, that means running lots of different risk reports with a high degree of position-level detail. And that is absolutely possible. The technology allows us to do this."

Speed is another element that is helping fund managers think about risk and fine-tune their portfolios. As risk systems improve, fund managers can understand their risk exposures and respond more adroitly; in the past, this may have been limited, in turn limiting how much capital they could safely deploy. Now, risk technology advances are presenting multifarious risk metrics, improving how portfolio risk is managed. A virtuous cycle ensues, as the more they analyse risk – with or without the help of machine learning tools – the more confidently they can deploy capital, improve the Sharpe ratio, and attract new investors in to the fund.

Ivan Popovic is Managing Partner at Tolomeo Capital, a Swiss-based quantitative fund manager that relies heavily on technology-driven investment strategies. Rather than buy best-of-breed risk systems, Popovic explains that the team built its own proprietary state-of-the-art risk measurement framework.
“The approach is fully generic and can incorporate any kind of asset class: from plain-vanilla exchange traded products to hedge funds, private equity and complex OTC derivatives. At the heart of the system lies the pricing kernel, which statistically analyses the return drivers of an asset.

“At the first stage, each position in the portfolio is modelled by itself. As a next step, the dependence structure of those return drivers are modelled, which results in Monte Carlo simulations of the P&Ls of each position whose co-movements behave as in the real-world. The advantage of this approach is that it allows for straightforward analysis of certain types of shocks which affect multiple assets classes,” explains Popovic.

Signalling risk
Additionally, risk factors which are currently driving the market can easily be identified in the system. These models are constructed bottom up and are not exposed to data-mining or over-fitting risks.

“It is our last line of defence to make sure we are aware of what kind of risks we are currently facing,” adds Popovic, confirming that AI and machine learning have been an integral part of Tolomeo’s trading system since day one.

“As the timing of an investment is not completely random, the risk in a trade is therefore dependent on the underlying signal. As the sizing depends on the signal it is therefore derived from machine learning and AI techniques. This is the first line of defence.”

Ivan Popovic, Tolomeo Capital

explore as a discretionary portfolio manager,” he says.

TCA and trade optimisation
To that end, one area that Atreaus Capital is using sophisticated analytics is in relation to trade execution; specifically the cost of entering and exiting trades.

“If you look at FX liquidity it is spread over multiple venues, multi-bank platforms and ECNs, etc, so what we’ve done is build an execution system through which everyone trades. That gives us all of the trading data, with which we can perform TCA analysis to see how each trader compares in terms of the cost of each trade executed, to try and optimise the process.

“We have the ability to measure real-time price movements and how difficult it is to get certain trades done in different circumstances with different banks. Using algorithms to optimise TCA addresses, in some part, concerns we might have about liquidity risk through the course of day or during different markets.”

Another possible application of data analytics is to think about how to optimise the timing of entering and exiting trades. Collating such data, regardless of whether it is a machine or a human doing the trade execution, gives investment managers the ability to convert that data into information, from which they might derive insights and arrive at new knowledge.

When someone is making money, how can they make more money? Equally, when someone is losing money, how can one use analytical insights to get them to reduce the amount being lost?
“You want to analyse what they do and make it better,” says Downes. “Reducing costs plays a part in both increasing returns and reducing losses; both of which are exercises in risk management.”

IBM Project Debater
Technologists are making huge strides in the application of AI and machine learning to help businesses of all shapes and sizes improve their operating models, and streamline workflow processes. IBM has leveraged Watson – the incredible supercomputer that uses deep learning algorithms to analyse data sets to generate insights - in all areas of industry. Its AI capabilities are being applied in healthcare diagnostics, trade finance, logistics, education and advertising.

This is cutting edge technology. Watson can work with the smallest data sets to learn and help businesses to advance their thinking. Soren Mortensen is Director, Financial Markets, IBM. He confirms that IBM has a series of API’s as part of their Watson Services that are geared towards cognition and problem solving (Thinking, Learning, Deciding & Acting) whilst others are geared towards human interaction (Perceiving and Responding).

"Within financial markets these API’s are used for the discovery of data and extracting any relationships that might come out of that data. An example of this is how quarterly weather improves revenue estimates in certain industries.

“The cognitive capabilities can identify, by analysing large volumes of both structured and unstructured data, underlying drivers affecting performance to offer better insight into companies of interest, which will enable the buy-side to make better investment decisions,” says Mortensen.

IBM also have debater technology where the system can listen to arguments, and respond convincingly with its own, unscripted reasoning to persuade an analyst to consider his position on a controversial topic. Based on vast, empirical sets of data, it can also help relationship managers create hypothesis to explore with their clients along with arguments to support these.

The technology can also help the investment manager to visualise the effect of news events on an individual company through natural language processing, graph database and visualisation technology.

“We are also using this technology, to assess how a price move on crude oil will likely impact all other asset classes and risk factors – and if your portfolio is exposed to those risk factors, as a consequence of the move, determine what the impact might be,” explains Mortensen.

The upshot to this is that the buy-side can leverage market data and cognitive capabilities to really understand underlying risk factors that impact the performance of a given portfolio.

“Investment managers want better insights into the companies that make up their portfolios to make better investment decisions – this is possible with cognitive technologies.”

Soren Mortensen, IBM

Model complexity risks
The risks or challenges of very advanced nonlinear machine learning techniques (e.g. neural networks, deep learning, etc) are that they can be seen as black boxes. This means that it is sometimes not clear how the input data leads to certain output data, which hampers the interpretation of the results and hence the decision making in risk management.

“This additional complexity adds another dimension of risk at the core of the risk management process, which can be also seen as a disadvantage,” opines Popovic.
"The addition of model risk does not necessarily improve the overall result or capabilities of the system. Sometimes, increasing complexity actually hampers the overall results of any (risk) estimation and adds a lot of variance to the estimation.

"A slight change in the input data might completely change the output. Hence using very advanced, relatively new and complex AI tools in risk management might add other sources of risk rather than offer an improvement to the whole risk management process.

"They certainly need to be used carefully as increasing complexity does not automatically translate into better results."

**Python scripting for risk reports**

Regardless of the extent to which hedge fund managers might use machine learning tools to improve risk management and measurement, what is irrefutable is that risk has become much more of an immediate requirement.

In the past it was more of a regulatory box ticking exercise. Now, managers want to know in real time what their risk exposures are to respond to their clients. Are they keeping everything within the right limits? If the markets are shocked in different ways and given the complexity of the instruments being traded, what does risk mean to me as a portfolio manager?

"Whereas managers might have been producing risk reports on a weekly basis they are now producing them several times a day to get close to real-time monitoring and management of risk," observes Kaye.

Derivitec have also pushed their reporting capabilities to support Python scripting so that clients can interface with their analytics using Python APIs to generate their own reports.

"It’s very important to support this because if you can’t present risk in an easy to understand, visual format, people will just ignore it. It means that clients are now better able to manage risk, with the whole organisation better informed of where the predominant risks are, whilst at the same time able to drill down to the last detail within a clear, graphical interface," comments Kaye.

Certainly with such massive volumes of data at their disposal, it is incumbent upon portfolio managers and risk officers to present portfolio risk analytics in a clean, uncluttered way. Otherwise, another risk is potentially introduced: paralysis by analysis.

Machine learning tools can help cut through the clutter and present salient points, either numerically or graphically, in order for investment teams to make split second decisions. This is the real power of the machine – crunching through zettabytes of data to seek out patterns in the numbers.

Back at Atreus Capital, Andrew Downes cautions against getting too carried away by offering these final thoughts in conclusion:

"Some managers have spent a lot of money hiring Silicon Valley engineers and I’m not sure they’ve been as successful as they set out to be in using AI in their investment processes. Having an unsupervised machine simply be fed data and be expected to learn a way to trade and make money is still a long way off in my opinion. Even if one managed to achieve that Holy Grail, how would you know that it could be repeatable in all markets? It’s hard to know what the deep learning algorithms would be doing and why.

"At the end of the day, to be successful you need to start with ML and other tools by keeping things simple, intuitive and try to improve step by step what one is doing; such as optimising TCA. Start with a simple objective and other things can follow."
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AI-based risk monitoring protects individuals

Interview with George Ralph

Technology risk cannot be underestimated, especially in today’s regulatory environment where GDPR rules place a heavy burden on securely protecting and storing personal data. Yet establishing a technology risk framework tends not to be a top priority for some hedge fund and private equity managers.

However, those who do take it seriously are moving their security posture beyond merely protecting the four walls of their organisation and more towards protecting the individual, cognisant that reputational damage – largely as a result of human behaviour – is only ever just round the corner. This mobile first thinking pushes managers to look and more forward thinking technology partners focus not on traditional solutions but evolving and next generation technology.

“People used to use a proxy that would sit on or within a firewall at their office, now we use (or certainly should use) products that sit hidden on the endpoints of their network and mobile devices to monitor web traffic on their laptop and user activity, no matter where it is in the world,” says George Ralph, Managing Director of RFA, a leading technology consulting group which offers a comprehensive range of IT services to alternative fund managers.

RFA has long been aware of this trend towards individual security and last year developed a sophisticated AI-based intrusion detection and prevention monitoring tool, called MDR (Managed Detection and Response). Rather than operating statically in a single environment like some intrusion detection systems, and which rely on humans to read the data logs to see if any suspicious activity has occurred on the network, RFA’s solution lets the machine do all the work.

“Our solution puts data collectors on the end points of the network and monitors the typical behaviour of each user. The AI component makes continuous decisions and generates alerts, if it notices something suspicious when monitoring the data logs, in extreme cases it will block the device and have the user call us (rather than the other way round).

“One client tested this system alongside a couple of other high-profile software providers where the portfolio manager deliberately started downloading a series of spreadsheets. The two other software systems did nothing because they did not consider it malicious behaviour, whereas our system blocked his machine immediately as it was unusual behaviour,” says Ralph.

Whereas a traditional IDS is designed to monitor network activity within the office, RFA’s solution goes beyond the network perimeter and is always with the individual, constantly monitoring traffic and generating alerts; be they at home on their laptop or travelling across the globe.

RFA provide a number of cyber solutions including user training through to certified data security audits and risk management implementations – however, they know that users still make mistakes and having an institutional grade security solution like this to catch mistakes is crucial.

Ralph says he is still amazed how many people still do not understand the value of technology protection.

“When we start working with emerging and new managers to the RFA programme, we try and give them the basic facets of what they need from a technology risk perspective. As their AUM grows, that framework has to evolve. At each stage of their AUM growth, we will come in and advise them on what additional elements...
to implement and then update their written information security policies.

“We also take on managers from existing IT providers who have never been given any advice and never had any meaningful level of engagement. The first thing we do is conduct a survey of the client’s IT infrastructure. If there are major gaps in their technology from a security perspective, we prioritise the highest risk items and implement a solution,” explains Ralph.

RFA has enjoyed a 70 per cent growth in 2018 across Europe. In the UK alone it now has a team of 50 staff, servicing 110 clients with their Luxembourg office growing at a similar rate. Monitoring staff cyber behaviour is likely to continue to increase, thanks to tools like those developed by RFA and other technologists which are leveraging the power of AI to detect when organisations might be at threat not just from external threat actors but their own employees.

“People still don’t perform phishing training exercises because they assume it’s too expensive yet it equates to approximately GBP75 per person per year,” exclaims Ralph.

“As consumers of tech we are very focused on convenience - this is why we developed our own GDPR compliant data tools to enable secure offline access rather than simply recommending off the shelf products - as technology guides we have to ensure that security is taken seriously but without taking away convenience, anything you take away has to be replaced with something equal convenient or better.

“We have a system which, similar to the MDR system referred to above, marks an employee who will be leaving the firm as a ‘sensitive user’. Before they leave, if they start changing their emails in the office or asking for file permission changes, the system will raise an alert.

“However, when fund managers implement tools such as this, they have to be very clear in their policies that everyone in the firm is being monitored.”

Going forward, individuals are likely to be increasingly monitored, even when working at home, as organisations look to stay one step ahead of technology risk in all its myriad forms.”
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The impact of the cloud on risk management

By George Kaye

Much has been written about the cloud and its impact on the financial industry, yet still the ‘cloud’ remains as nebulous a concept (pardon the pun) as Big Data or Artificial Intelligence. Nonetheless, the cloud is indeed one of the most important, if not the most important, technological innovations of this century. Naturally, as someone who has formed an entire business leveraging the near limitless potential of the cloud for effective risk management, I might be expected to hold such a view, but in this short article I will attempt to justify it. I hope, by the time I’ve finished, you’ll be as awestruck with the power of the cloud as I am.

The cloud IS risk management

The cloud, in a word, is about resilience. When you upload your thousands of can-never-ever-be-deleted holiday snaps to the iCloud, you do so because you absolutely must never, ever, EVER, lose them. The cloud takes your photos of you facing left to the sea, and you facing right to the sea, backs them up, and replicates them so that if, woe betide, your phone falls out of your pocket when you’re, coincidentally, by the sea, they are securely stored, for ever (or until you decide to delete them (perish the thought)). Now let’s apply this idea, somewhat less frivolously, to what you need as a risk manager.

First, you need data, and a lot of it. You need market data, at least end of day, but often live, usually over multiple asset classes, and you need it distributed to multiple users, spread across the world. The traditional solution to this problem was to go to an incumbent vendor and pay heavy fees for much more data than you actually need. In providing companies with an easy way to store and distribute data securely, the costs of data acquisition have fallen markedly.

We are now moving in the direction of the so-called ‘market data market-place’, as exemplified by such companies as Xignite and Quandl, where users can subscribe to exactly the data feeds that they need, at a cost in line with their usage. Whilst the models of the two companies are rather different, the building blocks are the same.

Across the world, financial data companies are acquiring data, validating it, storing it robustly and distributing it securely, without having to pay the heavy hardware costs of an on-site data centre. Those cost savings are passed onto you, the consumer. Of course, the usual headache of exchange fees persists, but at least now you’re paying for what you actually need, and can pay more when you need more. Indeed, it might even be argued that the increase in choice of affordable data sets can actually improve the reliability of data used, as the reliance on a single provider has been eliminated.

But of course, you, the risk manager will also need to run reports as of some point in the past. So, the data used need to be stored. With the advent of no-SQL databases such as MongoDB, you can create a resilient, properly managed database, replicated across the world, in nothing more than the time it takes to set up an account at say, MongoDB’s Cloud Manager. Amazon Web Services (AWS), as a case in point, has done a great job of linking together different cloud architectures to operate seamlessly within its own environment.

If you want to store your market data for post-hoc analysis, all you need to do is open an account at AWS, apply the security credentials to your MongoDB Cloud Manager account, and voila, you can now deploy a horizontally scaled, geo-replicated, periodically backed up database in AWS in minutes. Your market data is now resilient.
now you need to do stuff with it. You need to calculate reports, run analysis, compute value-at-risk, control risk limits, etc. Suppose you’re an expanding fund. The complexity and size of your portfolio will probably expand in line with your AUM, but do you have the technology to deal with it?

Suppose you’ve been running everything on in-house servers. Now you have to buy more servers and figure out a way of parallelising computation between them. With the cloud, resources are innately scalable. With the right technology (hint, ours) virtual machines can be spun up and down automatically in response to your needs. Should one server fail for some reason, another one will automatically be spun up to take its place. All of which means that you, the risk manager, will be able to compute your reports, whenever you want, regardless of the size and complexity of what you need to calculate. In short, your entire reporting framework is now resilient.

In fact, the whole model goes deeper still, as with the advent of things like AWS’s Cloud Formation, your entire cloud architecture can be re-created at a touch of a button. Data, services, backup processes, applications, the lot, in a data centre of your choice. You can now literally obliterate your entire risk infrastructure and re-create it in minutes. In other words, your entire risk operation is now without operational risk.

And finally, the cloud is in a constant state of development, as the rival platforms compete for market share. Services can now be scaled in seconds, rather than minutes. New technologies, be they block chain or so-called AI (machine learning, to give it its proper title) are being integrated seamlessly into the range of services available, allowing you to benefit directly from these innovations the moment they upgrade. Which means that not only is your infrastructure de-risked to the present, it’s an active participant in the future too. Now isn’t that what risk management should be all about?

I hope I’ve made you as excited by the power and potential of the cloud as I am. If you’d like to learn more about what the cloud can do for you, feel free to email me, George Kaye, at george.kaye@derivitec.com. Thanks for reading!