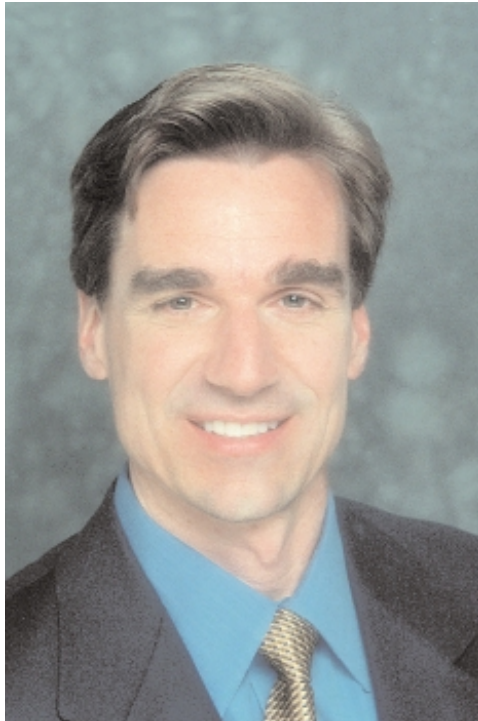


The electronic quant

Fast, efficient and inexpensive – artificial intelligence has produced a machine to program pricing models that is better than the real thing. Is this the end for the analysts, asks Clive Davidson



Curt Randall, Scicomp: 'One of the barriers to using PDEs is the perception that they are difficult to program'

analyst's options pricing model into a computer program. It takes one-tenth of the time a human programmer would take and produces better code, say its users, which already include two investment banks – Merrill Lynch and MeesPierson.

And SciComp is not alone. Other software companies are working along the same lines, aiming to automate more of the functions of the front office. As always, the aim is to achieve greater efficiency and reduced costs. So how long will it be before machines replace expensive quantitative analysts altogether?

Human programmers have always created software based on models developed by quantitative analysts. But SciComp has taken this a stage further. It has developed higher-level software that will take the information in a quant's option pricing model and automatically produce the pricing program – without the need for a human programmer.

According to Merrill and MeesPierson, SciFinance produces more accurate code, more quickly than a human operator. Furthermore, it can write code for partial differential equa-

that are ordinarily very complex become straightforward with SciFinance, says Gatheral.

The software package is based on technology called "software synthesis" – software that writes software. This is an area of artificial intelligence that has been under research for years. Computer scientists have looked at how humans set about writing programs, and have developed techniques for simulating this process. Automatic code generators have appeared, mostly generic in nature. Richard Tanenbaum, a partner at New York-based analytics software supplier Savvysoft, says he first investigated the technology about 15 years ago, but found that, as with many other artificial intelligence products of the time, it failed to live up to its promise.

Since then, as Alexander Sokol, director of research and development at New York-based analytics software supplier Numerix, points out, many ready-made components have become available for building programs, including generic components for things such as user interfaces as well as more specialised compo-

SciComp, based in Austin, Texas, has produced an artificial intelligence package that will turn an analyst's options pricing model into a computer program

Quantitative analysts don't come cheap; their activities are time-consuming and they can sometimes make mistakes. When they get it right – and model an institution's risks effectively – the treasury's coffers are brimful to overflowing. Get it wrong, however, and a debt-red stain will ooze on to their corporate copybook. The quant is only human, after all, and as such is fallible.

This has always been an unavoidable hazard, and comes with the territory – the quant's skills are rare ones and few have the technical and technological know-how that is required. Until now, that is.

For US company SciComp, based in Austin, Texas, has produced an artificial intelligence package – called SciFinance – that will turn an

tions (PDEs), which many analysts favour as the most accurate way to model many instruments, but avoid because of the programming difficulties.

Merrill Lynch's global equity-linked products group bought SciFinance in January, following extensive trials. Jim Gatheral, head of quantitative analytics for the group, believes it will not only improve the productivity of his analysts, but will also enable them to tackle more sophisticated problems realistically. For example, models of double-barrier options that involve non-linear transformations of co-ordinates are usually a tough proposition. Things

ments for financial systems.

Meanwhile, over the years researchers have been able to fine-tune the techniques for automating a generation of programs to produce consistent bug-free code optimised to run efficiently. This is no more than a good programmer would do, but the power of modern computers means that the machine can produce code as much as 10 times faster than a human programmer, claims Elaine Kant, founder and president of SciComp.

Kant has been a leading figure in software synthesis. In 1995, she set up SciComp with engineer and physicist Curt Randall to apply

In brief

Risk data modules evaluated

Massachusetts-based Meridien Research has evaluated the data models offered by several enterprise-wide risk management system suppliers. With systems integration costing up to 65% of installing a risk management system, Meridien believes that organisations should pay more attention to the data model of products.

"The driving factors in selecting a risk system are usually the analytical capabilities, performance and flexibility of a system, but we believe that the features of the underlying database should be a consideration as well," says Barbara Smiley, author of the report.

Meridien's report looks at the way that the systems handle data in terms of data elements, granularity of data, normalisation, documentation, transparency and data-loading performance. It reviews the data architectures and how users can extend them. But the report looks at only five of the risk management systems on the market – Algorith-



Barbara Smiley, Meridien Research: evaluating data models

mics' RiskWatch, C-ATS' Carma 3, Barra's Redpoint TotalRisk and Infinity's Infinity 7 and Panorama. It provides case studies that focus on issues such as managing data in global operations, support for complex modelling and user-friendliness.

software synthesis to finance. "The problems of finance are particularly suited to an automated problem-solving approach because of the flexibility and rapid modelling capabilities of software synthesis," she says. "In option pricing, for example, new types of contracts arise constantly while novel features are added to familiar structures. Even subtle modifications of contract terms often require completely new pricing algorithms."

Early code generators failed because they were too general to be of much practical use. A successful software synthesis system must not only know how to construct a program, but it must also understand the nature of the problem it is trying to solve and the techniques that it is to automate. Kant and Randall chose to focus first on options pricing using PDEs and built a knowledge of finance and mathematics into their system.

"One of the barriers to using PDEs, which can be very quick and accurate, is the perception that they are difficult to program. That's not unfounded," says Randall. Yet SciFinance not only knows what options are, it also knows about PDEs and how to program them efficiently.

"Using SciFinance to develop derivatives pricing models will save a tremendous amount of programming work," says Anna Shepeleva, a derivatives researcher with MeesPierson's investment banking division.

Well before the arrival of SciComp, many organisations that use derivatives had already

given up writing their pricing programs themselves. They have been buying program libraries, or components to create them, from companies such as Savvysoft, Numerix, Data Analysis Risk Technology (Dart), Marvin Software and TechHackers. But these have limitations, says Kant.

The libraries and components can have hidden assumptions that may be unrealistic. As these products are intended for a wide user group, they tend to concentrate on standard models. "They still require considerable programming and modification to produce pricing code for custom structures. This forces analysts to focus on the mechanics rather than concentrating on pure problem-solving," she says.

At the same time, SciFinance has its own limitations. It is only available for pricing options, whereas companies such as Numerix and Dart now provide a wide range of pre-programmed analytics. Randall says his company intends to extend the coverage of its software synthesis to pricing other instruments, and possibly into risk management.

SciFinance also only automates the programming of PDEs, and these are not suitable for solving all pricing problems. For example, an option on 20 assets could result in a model with 20 dimensions that would take so long to run as a PDE as to be impractical. Here, Monte Carlo simulation is a more practical approach.

Monte Carlo can also require considerable programming skill and computational resources. However, software suppliers, such as

Numerix and California-based Financial Engineering Associates, have been working on ways to make it easier and faster for financial organisations to run the simulations. Because these tools and the increased power of today's computers make it possible to program and run fairly large simulations in a reasonable amount of time, many analysts have been making increasing use of Monte Carlo. However, other analysts are wary of this trend, saying PDEs produce more accurate results more quickly for many types of problem.

"It's very hard to control the accuracy of the Greeks [the sensitivities of options to a number of factors that are commonly known by Greek letters] with Monte Carlo," says Gatheral. "With numerical PDEs you get very accurate Greeks if you do your work right."

SciFinance is also expensive compared with some libraries – a SciFinance licence costs from \$100,000 a year, whereas some suppliers, such as Mamdouh Barakat Risk Management, sell pricing programs for less than \$1,000 each. However, an organisation could use SciFinance to produce an unlimited amount of pricing programs.

Not alone

SciComp is not the only group working on sophisticated software synthesis. And several academics, including a group at Imperial College in London, have been trying to apply the techniques to finance. But, as with many good



Rich Tanenbaum, Savvysoft: 'You think you're doing something different then you find out that everyone's doing the same thing'



Jim Gatheral, Merrill Lynch: 'Software synthesis is the furthest you're going to go because modelling is an art as well as a science'

ideas, several people can be working on it simultaneously without necessarily being aware of each other's efforts.

Savvysoft is developing technology to generate code automatically in the C programming language from models specified in Excel spreadsheets. The aim is to allow analysts, traders and others to devise models, and for the technology to convert these quickly into programs the organisation can then integrate with its trading or risk management systems.

Savvysoft did not design its code generator for PDEs. However, the company has also been working on a generic solver that will take formulas, such as that for the payout of an option, and calculate their value. So an analyst could use this in conjunction with Savvysoft's code generator to automate a PDE.

Although Savvysoft has tackled the problem from a different angle, it is clearly headed in the same direction as SciComp. As Tanenbaum says: "You think you're doing something different then you find out that everyone's doing the same thing."

Although SciComp and Savvysoft both aim to sell their

products to analysts in financial institutions, they need not necessarily compete. There is no reason that Savvysoft could not use SciFinance or other software synthesis technology to write parts of its programs. In a highly competitive market, it may not have any other option.

"Even if we invest time and effort in a new technology and then something better comes along, we certainly want to investigate it," says Tanenbaum. "The only way we're going to continue to grow is to ensure we have state-of-the-art technology."

Is this the end?

So is this the final step towards replacing the analyst altogether and having a machine to develop pricing models?

Gatheral argues that the human factor is still key. "The art of modelling is to take an ill-defined problem and redefine it mathematically in such a way that it can be solved. That process involves making approximations, and knowing which approximation to make is basically the art of the modeller."

Numerix's Sokol agrees: "Computerised processes cannot easily replace market expertise and the understanding. Human judgement will always remain key to finance."

But while these views have some validity, they do not amount to proof.

In some ways, analysts' claims that their jobs could never be automated sound like the London International Financial Futures and Options Exchange's cries that it will always be an open-outcry exchange, as it gets dragged relentlessly towards electronic trading.

Organisations usually automate processes to improve efficiency and reduce costs. Analysts and traders are among the highest-paid employees on the planet. "Ownership of an obscure formula is not enough to demand a million dollars a year in salary in any other industry and I don't see why it should be in this one," says Michael Adam, executive chairman at New York-based software supplier Inventure.

Adam believes that demystifying the role of quantitative analysts by making the ability to analyse information more widely available in a financial organisation will re-

In brief

Credit risk cubed

Credix Financial Software, a new company based in New York, is developing a data warehouse system for credit risk management. Called CredixCube, the system will enable institutions to gather credit-related data from their various operational systems and integrate it for analysis and distribution, says Credix president Philippe Lecocq, who was formerly European manager for Pennsylvania-based Financial Software Systems. A key feature of the system is linked servers that allow individual users access and to customise the presentation of the data. One server will deal with credit exposure data, while the other will handle data on capital, including credit limits.

The company is currently producing a prototype of CredixCube and expects to release the product in the second half of this year

Mint links to CLS bank

New York-based middleware supplier Mint Technologies has developed an integration package for the Continuous Linked Settlement Bank (CLS). The bank, which aims to reduce foreign exchange settlement risk, is due to go live next year. The Mint package will allow the bank's users, initially its 60 shareholders, to link to the CLS and to manage and monitor the processing of their transactions, including trade confirmations, receiving pay-in schedules and sending funds transfer orders.

duce the premium they currently carry.

Meanwhile, Sokol sees the job of software developers not as being to automate the functions of the quantitative analysts "but to provide them with better tools to utilise their expertise profitably".

But at the very least, software synthesis such as SciFinance could lead to the deskilling of the quant. For example, SciFinance includes default methods for where an analyst does not specify exactly how he/she wishes to tackle aspects of the pricing problem – for example, the package will make "informed choices" about which solver or discretisation method to use where these are not specified.

As Kant explains: "As the modelling and numerical design trade-offs become better understood, the synthesis systems will be trusted to make more of the design choices and include intelligent default for numerical parameters, permitting the level of the specification language to be raised to levels that facilitate use by less mathematically expert people."

So it is possible the highly paid "rocket scientist" quants may have to go back to working on rockets, while sales people and traders develop their own models.

But perhaps humans do have a trump card in that they can learn and adapt better than machines – at least for now. **n**

In brief

Easier risk management

EasyScreen has developed risk management controls for its trading system for electronic futures and options exchanges.

EasyScreen, which is based in London and was formed last year by two London International Financial Futures and Options Exchange (Liffe) traders and software supplier Dealing Object Technology, first developed an on-line trading system for Liffe's Connect electronic equity options market. It has also developed a system for trading futures electronically and has now added risk management controls to this system. The controls include limits on open positions and automatic close-outs and stop-losses.

The company is busy developing interfaces to other electronic exchanges, such as Eurex. This will allow dealers to trade on a number of exchanges from a single screen.

Leveraged loans in MarginMan

Dublin-based International Financial Systems has added a foreign exchange loan and deposit module including risk management functions to its collateralised trading system MarginMan.

The module enables banks to offer a facility to clients to use collateral to trade on the money markets. The bank lends the client an amount in a certain currency with a

specific interest rate and repayment date. The client can then trade this amount on the foreign exchange markets for another currency and deposit the result with the bank at another interest rate but the same repayment date. The module will manage the transactions and the client's collateral and monitor the replacement cost of the loan.

The new version of MarginMan also includes Internet facilities for clients to view their accounts, including current open positions and portfolio status. The company plans to introduce Internet-based trading for clients later this year.

Reuters launches bond indexes

Reuters is introducing three euro-denominated bond indexes using a new formula developed with Commerzbank and German software house Moosmüller & Knauf.

The first of these, Reuters Euro Pfandbrief Index, went live in January and is aimed at fund managers, portfolio managers and others operating in the Pfandbrief market, one of the largest bond markets in Europe. Later this year, the company will introduce the Reuters Euro Emerging Markets Bond Index and the Reuters Euro Corporate Bond Index.

Commerzbank has provided the concept and historical data for the indexes, Moosmüller & Knauf the software to calculate the figures and

Reuters is distributing the data.

Christian Mathies, marketing manager for fixed income at Reuters Europe says: "The new indexes are designed to become benchmarks in the euro bond markets."

The January sales

International Finance Corporation, a member of the World Bank Group, has licensed the ToolsXpress toolkit from New York-based Numerix to build pricing programs for exotic interest rate structures and value-at-risk models. The UK division of Japan's Mitsui & Co has bought the FXAT foreign exchange and money markets dealing system from Alphametrics, based in Hertfordshire, England. Ohio Savings Bank has bought the Convergence asset-liability management system from Boston-based BancWare to model complex instruments and prepayment risk among other things. In the UK, the Woolwich bank has installed the r:Frame system from European supplier CMG to report on capital adequacy, while the government's newly formed Debt Management Office has installed the CityVision Real Time Publisher from London-based Arcontech to manage the collection and distribution of financial data.