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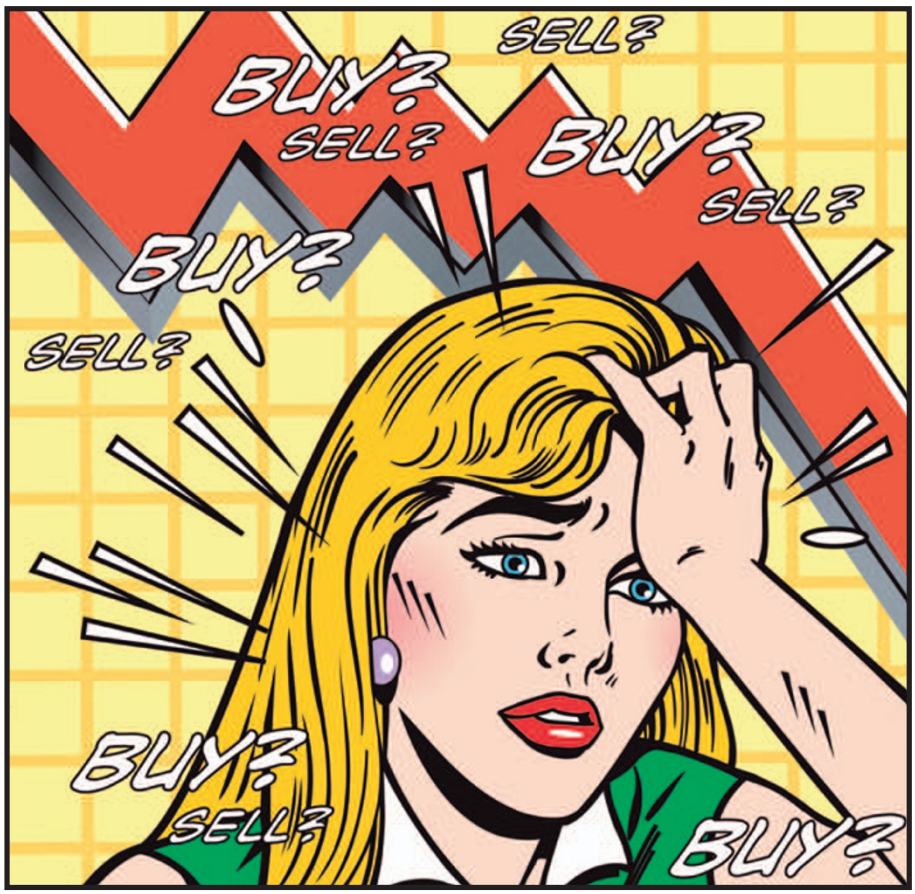

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FINANCE

Quantifiable prospects

Despite market gyrations, banks can offer mathematicians and physicists a way to put their acumen to lucrative use.

BY DAVID LINDLEY

After a couple of postdoctoral fellowships in the mid-1990s, Ben-Ami Gradwohl, then a physicist in Los Angeles, California, faced a tough market for tenure-track academic positions. And he had doubts about devoting his career to one particular strand of academic research. By chance, he started reading a book on the mathematical methods behind option pricing — how to determine the costs of tradeable contracts for buying or selling assets — and came across references to some papers not generally available in libraries. He got in touch with a manager at Leland O'Brien Rubinstein (LOR), a now-defunct investment firm in Los Angeles, who offered to send him copies of the papers in return for his résumé. That was when Gradwohl's career took a turn.

He did some consulting at LOR, which helped him to learn the mysteries of finance. Even after that, he was still considering pursuing research in high-tech industry or solar energy. But he took the plunge and went into finance full time, first with LOR and then with Nicholas-Applegate Capital Management in San Diego, California, where he analysed and guided investment portfolios. More than 15 years later, Gradwohl is still in the field, working as head of portfolio strategies and enterprise analytics at CitiMortgage, part of Citigroup in New York. It has been a long time since he did any programming or mathematical analysis, but his skill with numbers remains an asset.

Knowledge of sophisticated mathematical modelling techniques still provides a toehold for entry into some specialized jobs, but it's no longer quite so easy for people with a PhD and no prior knowledge of the field to walk into a well-paid job. Among scientists, there's a "widening pool of people who have realized that finance is attractive", says William Perraudin, director of Risk Control, a London-based company that supplies credit-risk software and models to banks and financial institutions. That growth in the talent pool has created greater competition for employment and, says Perraudin, "a gradual ratcheting up of the requirements for entry" in terms of experience and knowledge. On the other hand, recruitment is beginning to pick up again after the economic upheavals that began with the collapse of the Lehman Brothers global financial-services firm in 2008. Employment "hasn't yet recovered to pre-crisis levels", says Dara Lubarsky, a recruiter with the international agency Huxley Associates in New York. "But there's definitely an upswing."

MONEY AND MATHS

The incursion of deep mathematics into the financial world has its roots in a paper by economists Fischer Black and Myron Scholes (*J. Polit. Econ.* **81,** 637–654; 1973). The perceived value of an option depends on the market movements that traders consider probable; Black and Scholes constructed a model that determines an optimum price using a simplified picture of typical stock-market variations. Their innovation led to 'hedged' investments or portfolios, which are designed to maintain their value regardless of market movements. It also offers insights into investment risks, allowing analysts to form quantitative ▶

estimates as to whether prices are likely to deviate from optimum values. From the model sprang a huge sector of finance based on the purchase and sale of derivatives: financial instruments whose value is derived from movements in the prices of the assets on which they are based.

The Black–Scholes model is a set of partial differential equations, so institutions interested in exploiting it need people at ease with mathematical systems and programming techniques. Jennifer Hodgdon had done postdoctoral work on models and software for materials science at Bell Laboratories in Murray Hill, New Jersey, before she went to work at Goldman Sachs in New York in 1994. Her job there, writing software to implement mathematical models for complex derivatives in commodities and foreign exchange, was in technical terms not so different from her previous work. She says she basically "didn't know anything" about finance, but "picked it up quickly".

J. LEYNSE/CORBIS

The *Charging Bull* statue on Wall Street in New York.

When Hodgdon entered finance, she says, there was just one book — *Options, Futures, and Other Derivative Securities* by John Hull (Prentice Hall, 1988), later renamed *Options, Futures and Other Derivatives* and now in its eighth edition — that she and all other aspiring quantitative analysts read. But starting about 10 years ago, several universities, most of them in the United States and the United Kingdom, have developed master's-level courses in 'computational finance' or 'financial engineering'. These are typically aimed at students with an undergraduate degree in a maths-based subject, and teach the basics of markets, securities and investments, along with the mathematical and statistical methods that are used to track and model financial systems.

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"You can't teach a finance person quantitative skills, but a scientist can learn finance."
Ben-Ami Gradwohl

Gradwohl would advise anyone who develops an interest in finance as an undergraduate or earlier to enrol in a financial-engineering postgraduate programme rather than embarking on a PhD in physics or another 'hard' science. However, those who decide to enter the financial world having already earned a science PhD that gives them deep mathematical skills might well have a competitive edge in certain positions. Lubarsky notes that firms that concentrate on risk analysis and management usually prefer graduates of financial-engineering programmes, who learn relevant statistical and econometric techniques, whereas banks or companies looking to devise complex derivatives are more likely to want people with science PhDs. Jobseekers with a science background should at the very least read several books about what quantitative analysis involves and learn the basics of investment before approaching potential employers. Those who are knowledgeable and persuasive in interviews don't necessarily have to "tick all the boxes" in terms of formal qualifications, says Perraudin.

FINANCIAL INCENTIVE

For people entering the industry from academia, the salary of a quantitative analyst is a welcome change. A new hire with a PhD can expect to earn between US$85,000 and $110,000 a year, says Lubarsky, and could double that with bonuses; those with financial master's degrees should expect to start at roughly $65,000. But there are potential constraints. Locations are limited: the bulk of the work has traditionally been in New York and London, with smaller and less developed outposts in Tokyo, Hong Kong, Singapore and some other Asian cities. But that picture has begun to change as the job market diversifies, says Gradwohl. In the 1990s, quantitative analysts almost all worked on the 'sell' side of the financial world, analysing complex derivatives for companies that recommend and sell securities to investors. But today, many are on the more geographically widespread 'buy' side at hedge funds or asset-management firms, where they use their analytical skills to evaluate investments for companies that manage investor portfolios, says Gradwohl.

The work itself can be narrow and limiting at first: junior quantitative analysts spend their time using existing financial-analysis models for routine applications. "The standard model is not scientifically accurate, but it's the model they use," says an analyst who moved into the field from physics and is now working in Asia (his company required anonymity). He no longer has the freedom to choose how he spends his time on different projects, as he had in academia. "You do what people want, you do it on time, and you do it right," he says. Nevertheless, there are plenty of long-term prospects that offer some independence on the buy side or in management, for example, for those who are enthusiastic and adaptable: "If people like you, you can do whatever you want."

Hodgdon spent only a few years in finance before deciding to move on. She got tired of working in New York and had no desire to embrace a lifestyle in which people spent their large salaries nearly as quickly as they earned them. "I don't regret it, but I wouldn't do it again," she says. She moved away from the city and took a variety of other jobs — for which having Goldman Sachs on her résumé was a decided advantage — before setting up her own software company. Only those who genuinely like finance should pursue the profession, says Gradwohl: anyone who takes a finance job as a last resort or purely for the salary isn't likely to thrive. Perraudin agrees that the working environment doesn't suit everyone. "You're surrounded by hard-charging, aggressive people," he notes. "A large bunch of people get sick of it and disappear."

But for those who take to it, finance can be exciting and interesting. When he first started out, Gradwohl worked on the buy side for several years, managing portfolios and monitoring investment performance; he received "immediate gratification" from seeing whether he was outperforming the competition. He has also come to appreciate the enormous and varied intellectual challenge of his work. Being in finance has broadened his horizons: Gradwohl's work has touched on everything from game theory to sociology. "I couldn't do it without physics, but physics wasn't enough," he says.

The economic upheavals that began in late 2008, driven by trading in complex derivatives chiefly based on housing markets, have changed the nature of finance, but have not diminished the need for quantitative analysis. Many of the exotic instruments most closely linked to the crisis — from 'collateralized debt obligations' to 'credit-default swaps' — have been swept away by the market and regulators, says Perraudin. But the urge to make money remains. Banks and hedge funds are continuing to explore new investments and securities. Extra regulation has, in fact, boosted the demand for risk analysis and management, he says.

Skilled quantitative analysts understand the risk of systemic failure and the limitations of quantitative models, suggesting that they will be in demand for the foreseeable future. "You can't teach a smart finance person quantitative skills," says Gradwohl, "but a smart scientist can learn finance." ■

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