УДК 001.89

CURRICULUM ADJUSTMENT THROUGH UNIVERSITY AND BUSINESS COLLABORATION ON THE EXAMPLE OF AGH UST AND HSBC

T. BOCHACIK, P. MORKISZ, Ł. STĘPIEŃ, A. WEGERT
Faculty of Applied Mathematics
AGH University of Science and Technology
Kraków, Poland

Modern times present many challenges to the financial industry. In a rapidly changing world, banks and other financial institutions need to adopt and make right choices in a very short time. Hence, the decision-making process is increasingly relying on the outputs of mathematical models. This creates splendid job opportunities for graduates in Mathematics, Physics, Quantitative Finance, and Econometrics. Candidates with academic background in one of these disciplines are sought after by teams which design, implement, maintain, and validate models.

Mathematical modelling in finance dates back to the 17th century when the «unfinished game» problem was jointly solved by two famous mathematicians, Fermat and Pascal. The development of probability theory and stochastic processes laid the foundations of rigorous description of market price fluctuations (for details see [1]). An important step in the history of financial mathematics was the famous Black-Scholes equation and the formula published in 1973 (see [2]). Popularity and applicability of the Black-Scholes model led to the use of mathematical methods in banking industry on a large scale.

Nowadays, mathematical models in finance are used not only for pricing bonds, derivatives, and other financial instruments. They underly hedging, reserves calculation, assessment of credit risk, algorithmic trading, they help to adopt to market movements, and make business decisions. Specialists who apply mathematical methods to financial problems are called quantitative analysts or shortly quants. Quant jobs are usually challenging – they require strong analytical skills and mathematical background, understanding of financial concepts, programming and communication skills; as well as very rewarding – they involve working in international environment, provide constant development, and are well-compensated. It is no surprise that many high school graduates choosing Mathematics as their field of study consider a career in financial industry.

To meet expectations of current and potential students, Faculty of Applied Mathematics at AGH UST offers comprehensive preparation for the future specialists in the field of mathematical finance. Its program combines extensive studies in classical branches of mathematics with deep knowledge of modern applications and practical skills. From the perspective of financial mathematics, the most important basic courses are mathematical analysis, linear algebra, probability theory,

stochastic processes, and mathematical statistics. More specialist courses include stochastic calculus, stochastic differential equations, discrete and continuous models of financial markets, econometrics, option pricing, risk management, actuarial science, and various courses in numerical methods, algorithms or programming.

According to the surveys conducted on a yearly basis by AGH Career Centre ([3], detailed reports are available on request), the majority of the graduates found a job in a financial sector or IT field in 2019 (40,0 and 30,0 % respectively). The gathered data indicates that 91,3 % sectors of employment were in line with the responders' qualifications and skills gathered throughout the period of studies. Moreover, 60 out of 73 alumni (84,2 %) declared their higher education qualification at least sufficiently adequate for their job. A vast majority of graduates mentioned IT skills (79,5 %), and knowledge of foreign languages (64,4 %) as decisive and crucial in a recruitment process. The data updated every year indicate current trends and the market expectations for the mathematics degree holders, which shapes the directions and teaching methods for tertiary education.

Over the last few years, the Faculty together with the biggest financial corporations operating in Kraków have undertaken numerous initiatives to establish close collaboration. Companies sponsor and participate in events organized by the university (e.g., students' conferences). Experienced workers deliver talks and workshops for students; sometimes also academics are invited to give lectures for the staff of quantitative teams in companies. Representatives of business advise on the program of studies to keep it relevant to the needs of the job market. Finally, some of the courses offered to students are conducted in cooperation with companies. In the next paragraphs we will present two courses on which the Faculty will collaborate with HSBC – one of its leading corporate partners.

In 2012 the Faculty together with one IT company started to deliver Java course. The course was developed for the postgraduate students and the curriculum was designed to present and teach all the aspects required from the junior Java developers. The course was conducted in the following formula: it consisted of two parts – a theoretical lecture and a practical lab. The lecture was given by an academic person but the lab was conducted jointly by a lecturer and a senior Java developer representing the company. Starting from Spring 2021 this course will be a joint project of the Faculty and HSBC. Principles will remain unchanged, but more focus will be put on financial applications.

The most recent example is the new course that will be launched in Spring semester 2021, i. e. «Option pricing in Hull-White model», which will be coordinated by both academic teachers from the Faculty and qualified members of Independent Model Review team at HSBC. The course aims to mimic real challenges that model reviewers face in their work. In theoretical part students will

recall and extend knowledge of stochastic analysis, interest rate derivatives and pricing concepts. They will also learn basics of Credit Valuation Adjustment (CVA) methodology. As one of the tasks, students will receive documentation of a pricing tool based on the Hull-White model (classical stochastic interest rate model) specially prepared by IMR and containing gaps which will require independent investigation by the course participants. Practical part covers introduction to Python – the most popular programming language in finance, implementation of the Hull-White model and interest rate products pricer, and Monte Carlo simulations. Students will also learn about model validation and testing. Final grade will be based on a project.

Such collaboration is valuable for all the parties. Faculty broadens the courses offer and practically guarantees skills needed to find attractive employment after graduation, the industrial partner has a chance to identify, train, and then hire relevant talents. But the gains go beyond it - the students have a chance to work with real senior specialists from the industry, they can see how they operate, ask relevant questions, and decide if they want to pursue this type of career. Finally, for the experts involved from the industrial partners' side, it is not only a challenging task but a change from everyday work routine that brings a lot of satisfaction. Our experience is that this type of joint efforts is very pleasant and profitable for all the parties. The collaboration can also be taken beyond this, e.g. master or PhD thesis supervised by both industrial and academic mentor, working on scientific papers together or conducting real research by the academic experts for projects sponsored by the industrial partner. All those are currently discussed and we believe will soon take place.

Finally, we believe that this type of close collaboration between financial institutions and academia is inevitable as the applied techniques are increasingly demanding, including data science, machine learning, deep learning. For any industry to stay cutting-edge it is crucial to be aware of the scientific state-of-the-art novelties. Nonetheless, working on real world examples is very inspiring and give direction to the researchers.

СПИСОК ИСПОЛЬЗОВАННОЙ ЛИТЕРАТУРЫ

1. Akyildirim, Erdinc & Soner, H. (2014). A brief history of mathematics in finance. Borsa Istanbul Review. 14. 57–63. 10.1016/j.bir.2014.01.002.

2. Scholes, Myron & Black, Fischer. (1973). The Pricing of Options and Corporate Liabilities. Journal of Political Economy. 81. 637–54. 10.1086/260062.

3. Mode of access: http://www.ck.agh.edu.pl/en/badania-losow-zawodowych-absolwentow/.