Training of Financial Technology Specialists with RTU Bachelor Program in "Financial Engineering"

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Abstract

The combination of financial theory, mathematics and computer technology has led to the emergence of a new profession: Financial Engineering. Financial engineers apply advanced economics theory, recent mathematical methods and computer technology to financial markets and financial management. The program of professional studies in Financial Engineering has been running at the Faculty of Computer Science and Information Technology, Riga Technical University since 2009/2010 academic year. It is the first professional program in Financial Engineering in Latvia. Despite the fact that it is the mathematical program, it is popular among potential students of Riga Technical University. The aim of this article is to provide the information you need to prepare for the immediate goal, be it a stronger applicant to the top graduate programs, a better job applicant, or a more successful professional.

Keywords: Bachelor Program, Financial Engineering, Training of Specialists

Introduction

Over the last few years, applications to financial engineering, mathematical finance, and similar programs have grown steadily despite a very difficult environment for global financial services. A profession where mathematical, programming, and finance knowledge can be combined remains a popular career choice among many students with a quantitative background. Candidates with strong technical skills will be in high demand for the foreseeable future, but the required skills and domain knowledge are rapidly changing, especially with Solvency II directive for the finance.

Financial engineering as any other branch of science is influenced by globalisation and increased speed of information exchange. It means that financial engineering like many other branches obtains more interdisciplinary characteristics - the use of its conclusions in different spheres of life becomes more important. There it should be mentioned its use in industry, social sciences, including all branches of economy, marketing, insurance. Development of information technologies, that has allowed uniting financial and securities market in one data network, has changed the image about traditional stock exchange and has made a real revolution in widening the use of mathematical methods. Most of the western countries have timely, adequately evaluate these new possibilities, and have made infrastructure for introducing innovations in financial field. They have made reforms in financial education by

introducing study programmes for training financial analysts. In these programmes, duly important role has been granted to the methods of mathematical statistics and software. Methods of financial engineering should be acquired not only by the students of financial sciences but also economists, engineers, psychologists, sociologists and by many other specialists. Therefore, the course of financial engineering is included in the programmes of the most of higher educational establishments. Its integral part is provision of software.

1. Study Content and Organization

The study programme "*Financial Engineering*" is a new interfaculty study programme, which is implemented at Riga Technical University since academic year of 2009/2010. It is being implemented in collaboration with the Faculty of Engineering Economics and Management of Riga Technical University.

The aim of this interdisciplinary programme is to ensure acquisition of theoretical knowledge and practical skills in the spheres of finance, mathematics and information technology required for achieving appropriate professional competencies upon completion of the professional bachelor education compliant with the professional standard of Financial Analyst (PK 2441 13, PS 0223). This would allow the graduates to occupy relevant job positions, to have competitive advantage and to be well adapted to the labour market, as well as it would provide them the opportunity to continue studies for obtaining a degree at a more advanced level.

The tasks of the study programme are to provide the appropriate level of education for studies in a master's study programme (actuarial studies, financial analysis studies, studies in statistics) or for professional work. After the graduation from the study programme students are expected:

- to have basic skills in financial information analysis, actuarial technologies and main relevant methods;
- to be able to identify financial and actuarial problems that can be solved by applying information technologies;
- to be able to analyse business-related processes;
- to be able to manage optimisation of securities portfolios and investments;
- to be able to analyse, model and forecast financial flows, as well as to design management systems for financial analysis;
- to be able to explain basic principles of the use of financial instruments;
- to be able to assess profitability and risk of financial investments, as well as to come up with recommendations for reduction of financial risks;
- to know how to deal with economic and social factors in statistical analysis of financial flows;
- to be able to conduct statistical analysis of indicators such as mortality, functional disorders, etc.;
- to be able to analyse insurance market trends and calculate insurance losses and premiums;
- to be able to apply modern quantitative methods in financial analysis and financial engineering;
- to be able to use financial, mathematical and statistical software.

In addition, graduates will have attained strong mathematical basis and deep understanding of fundamentals of mathematical modelling of financial processes what

allows them be adaptive for frequently changing local or global circumstances and development of the single market.

Professional bachelor's study programme "Financial Engineering" is a 4-year full-time study programme with a student workload amounting to 160 credits (equal to 240 ECTS credits). Each academic year consists of two terms; each term is 20 weeks long and is divided into 16-week study period and 4-week examination period.

In order to attain the goals and objectives of the study programme, during the first year, students take compulsory general education courses and general courses related with the field of study that create a background for acquisition of specific knowledge and practical skills in future. Upon undertaking the studies, students receive a brief informative material containing the most essential information on organisation and practical process of studies; students also take an introductory course into the relevant field of study for which they are awarded one credit.

The study programme fully complies with the Cabinet of Ministers Regulations No. 841 of 20 November 2001 on the compulsory curriculum of the professional bachelor's study programme and consists of the following courses:

- general education courses – 20 credits;
- basic theoretical courses in the relevant field of study – 36 credits;
- professional specialisation courses in the relevant field of study – 60 credits;
- elective courses – 6 credits;
- internship – 26 credits.

Part A or the compulsory part of the study programme consists of 90 credits. Part A is comprised of the following courses:

- general education courses – 15 credits
- basic theoretical courses in the relevant field of study and courses in information technology – 39 credits
- professional specialisation courses in the relevant field of study – 36 credits

Part B or the required elective part of the study programme consists of 26 credits. Part B is comprised of the following courses:

- required elective courses in the field of specialisation – 20 credits
- courses in humanities/social sciences and management – 2 credits
- language courses – 4 credits

Part B consists mainly of courses having topical professional specialisation and they prepare students for practical work.

Part C or the elective part of the study programme consists of 6 credits.

Undergraduate internship consists of 26 credits.

State examination (bachelor's thesis) consists of 12 credits. Bachelor's thesis is an independent research on an issue topical in the sphere of finance. Goal of the thesis is to identify student's ability to apply theoretical research methods in analysis of practical situations.

Internship (practical training) what starts on the 2nd term of the 3rd year and continues into the 1st term of the 4th year (16 + 10 credits) is held within the contract between RTU and Latvia's key enterprises in finance and insurance sectors. Students are offered a list of possible enterprises offering internship. Places for internship are provided in compliance with cooperation agreements concluded between the University and enterprises. Contracts for the internship for the 3rd year students have been already concluded. Themes of practical work are closely related to with practical subjects already familiar to students. Internship is aimed to acquaint students with activity and functioning of relevant enterprises and transform their knowledge to

skills particularly in accordance to demands for professional qualification of financial analyst. Internship is tightly correlated with the students' future professional career.

2. Studies and evaluation of knowledge

Upon enrolment in the programme students, receive informational material containing the most significant information about the organisation of studies, practical realisation of the Programme. They are also offered a course "Introduction to the field of study" (1 credit). During the first class, the academic staff introduces students with the requirements for the assessment of knowledge and skills within the study course. The assessment criteria are also available in the electronic learning environment ORTUS. This system provides students with information on a particular course, the requirements for the acquisition of the course as well as methodological materials. Use of ORTUS provides an opportunity for the academic staff to increase the quality of work and offer additional educational material to students. In the electronic environment, students can keep track of their academic performance and grades. The use of technology and information exchange increases the efficiency of classroom work and encourages students to work independently. The interactive electronic environment ORTUS www.ortus.lv is regularly used both by students and by academic staff and can be accessed by authorized users only.

ORTUS offers important information on study subjects (course descriptions, requirements for the assessment of knowledge and skills in a particular subject, lecture plans, learning materials, the list of the necessary literature, etc.), information about students' achievements and completed study subjects, important messages, library news, access to textbooks and scientific literature, databases, e-mail, etc.

The electronic learning environment makes it possible for the students to communicate at specified times with their teachers and with their fellow students about the current courses. Online discussion forums have been created and regular questionnaires are held. The portal has been operating since the end of 2007 and it is continuously being developed and improved. The students and the academic staff undergo training how to most effectively use this portal. It is a huge step towards further improvement of the quality of the study process and towards ensuring democratic relations between students and the academic staff.

After every course, students have to take tests or examinations. Type of assessment is set forth in the study programme. Students are examined or tested by academic staff. Lecturer determines form of examination or test (oral, written or mixed). Content of each examination or test matches the content of each course and corresponds to requirements set for skills and proficiency in the Occupational Standard.

Proficiency in compulsory courses is tested in an examination (examination is also taken to complete each part of a course consisting of several parts); exceptions include courses with one credit, Sports, and courses that according to the Vice rector for Education can be completed by taking a test. Proficiency in required elective courses, which consist of several parts, is tested in an examination that is taken for each part of the relevant course. Other courses can be completed by taking either an examination or a test. Learning outcome is assessed with grades in the 1 – 10 range or with a pass/fail evaluation. Relevant course is completed successfully if a student passes a test or receives a grade in the range from 10 (with distinction) to 4 (almost satisfactory) in an examination.

In the majority of courses, especially during the first study years, the system of regular testing is used; namely, teachers give regular tests, tasks, practical or home assignments. Student participation in seminars is assessed as well. At the beginning of the term, students are informed about the weight these regular assessments carry in the final assessment of the course. This approach is used for assessment of the first-year students, and it has been concluded that it helps students to organise their studies. In some courses taught in the final years of study programme practical assignments are substituted with individual assignments which can be carried out by students after study hours at a time convenient for students. These assignments are assessed with grades defended in order to demonstrate proficiency and skills.

Credits are awarded for each course that is regarded as completed after student has received a grade that is 4 (almost satisfactory) or higher in an examination or has passed a test.

Information on the terms and requirements concerning final examinations or tests for each course, internship programmes, and requirements for internship report defence is made available to students.

3. Scientific research work of the academic staff and students

Academic staff of the study programme Financial Engineering is actively involved in research by taking part in international conferences and international research projects. Thus, teachers improve their skills and practical experience which are later used in the teaching process – teachers inform about new trends in the sphere of finances and apply modern teaching methods.

During last decades, modern natural sciences have been developing rapidly; that is related with analysis of dynamic system behaviour in random environment. It has become obvious that it is not enough to be aware of the average dynamics of a system – there is a need to have an ability to analyse complex chaotic oscillations of phase coordinates that are hard to predict. These skills are used not only in theoretical studies but are also widely applied in practice. One of the most vivid examples is a well-known Black-Scholes option pricing formula and algorithm for rational activity of stock market participants that identifies statistical uncertainty of financial flow.

Therefore, many study programmes intended for financial analysts contain courses where methods and algorithms of stochastic analysis are used in assessing parameters of computer regression models. Academic staff of the study programme Financial Engineering must have a high level of knowledge in the theory of modern stochastic dynamic systems and their practical application. Research activity of academic staff of the Chair of Theory of Probability and Mathematical Statistics of the Riga Technical University complies with these requirements. All teachers at the Chair have been awarded with their degrees for research on stochastic dynamic systems and their application. Furthermore, entire academic staff of the Chair is still actively studying stochastic analysis and its application in solving problems in financial engineering. For more than a decade, a seminar on Stochastic Analysis and Financial Econometrics has been organised under the auspices of the Chair. Research projects have been implement successfully (in the period from 2001 to 2004 – grant No. 01.0579 of the Latvian Council of Science for studies on Asymptotic Methods of Stochastic Analysis; and in the period from 2005 to 2009 – grant No. 05.1879 of the Latvian Council of Science for studies on Asymptotic Analysis of Stochastic Stability).

The following doctoral thesis have been written and defended: in 2007, Normunds Gūtmanis defended doctoral thesis on *Sensitivity Analysis and Forecasting of Conditionally Heteroscedastic Regression Models* and in 2009 Jolanta Goldšteine defended doctoral thesis on *Asymptotic Methods for Linear Markovian Iterative Convergence Analysis*.

Currently there are five students studying at the doctoral study programme *Mathematical Statistics and its Application* implemented by the Chair; their doctoral thesis are related with development of algorithms and methods for analysis of stochastic dynamic model regression in financial analysis. Scientific achievements of academic staff of the Chair can be used in training high-quality specialists in applied statistics and financial econometrics.

Methodology for stochastic analysis of regression models (diffusion approximation with Ito equation) devised by professor Viktorija Carkova and docent Oksana Pavļenko are used in teaching courses *Econometrics* and *Monte Carlo Methods in Financial Engineering*. The above-mentioned examples are used not only in the study process at the Riga Technical University but also at other institutions of higher education, including the study programme *Mathematical Statistics* offered by the University of Latvia as well.

Students are actively involved in research projects. Every year, in conjunction with celebration of the anniversary of the Riga Technical University the International Research Conference is organised.

Every year, in April, annual research conference of students is organised by the Riga Technical University which provides a platform for students to address theoretical and practical issues and to discuss the conclusions in a broader circle.

Every year, in September and January, the Riga Technical University hosts the Conference on Innovations and Modern Technologies. Within the framework of the Conference, research projects of the Riga Technical University and research projects funded by the Riga Technical University and the Ministry of Education and Science of the Republic of Latvia are presented.

4. Preparing for a career in the field of Financial Engineering

In most disciplines, including business and economics, there is an increasing awareness of the need to comprehend basic financial engineering methodology and its language for successful careers in business industry, government, and self-employed positions. Today, with the widespread use of computers the collection and analysis of data for decision-making are, for many enterprises, essential activities for efficient operations. In a typical organization, perhaps only few individuals are directly involved in the finance, but many others must have a sufficient understanding of financial engineering to interpret the analyses in order to make reasonable and timely decisions. Therefore the main task of teaching financial engineering in education establishments giving professional education is not only to teach students to know different formulas, facts and relations but to teach how to use their knowledge in practice, understanding of financial data and results of analyses, possibility not to make mistakes in their conclusions. Such "financial engineering" course asks for balanced presentation of fundamental financial concepts and methods, along with practical advice on their effective application to real-world problems. However, it cannot be only about applying formulae. These courses has to be about understanding assumptions and principles of the methods and interpreting the results in an applied, problem-orientated context. Therefore, the conceptual foundation of each chapter should developed carefully up to that level needed for prudent and

beneficial use of statistical methods in practice. The teaching of financial engineering differs from teaching of many other subjects because students must not only absorb a set of basic concepts and applications but they must also acquire new language. However, for students of business and economics, familiarization with this language and a working knowledge of the methods of probability and statistical inference are minimal requirements for mastering the complexities of economic forecasting, production control, and marketing research.

While the job market is very soft for new Financial Engineering specialists' hitting, the market to be desk quants, as well as those in exotics and structured finance, there is a significant need within risk, and quant developer/programming fields right now. We anticipate this need will only grow stronger over time as there is significant emphasis on risk and credit at the moment - and the near future - specifically as it relates to the current regulatory environments both here and abroad.
The other area, that is very bright now is within the world of automated, algorithmic, systematic, and quantitative trading. These roles are highly competitive for entry-level professionals. Further, they all require programming skills in core languages, along with a solid knowledge of statistical, neural network and/or artificial intelligence methods.

If we are more interested in the mathematical side, a PhD is the preference in future. Typical coursework for these careers is Operations Research, Applied Mathematics, Mathematics, Electrical Engineering, Computer Science or Engineering, and Mechanical Engineering. If you decide that, this is the path to pursue, understand that strong programming is a requirement and will be done every day. It is no longer optional. And, if you can only program in MATLAB, SAS, S+ or another RAD or statistical package, you will be at a disadvantage compared with those who can program in advanced languages mentioned above.

5. Conclusions

It should be considered as one of the most important tasks of Latvian scientists and engineers - to find their place in the context of Europe. As Latvia does not have natural resources that could be offered to the European market and as we do not want Latvia to become the country of cheap labour thus the only possibility for Latvia is to offer its know-how in order not to become second-class province of the European Union. We can compete in intellectual market but only when we are able to offer the right product with the right quality and if our educational system corresponds to the high quality demands set by today's life.

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Authors

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