



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Vilniaus universiteto  
**STUDIJŲ PROGRAMOS FINANSŲ IR DRAUDIMO**  
*MATEMATIKA (valstybinis kodas - 612G17001)*  
**VERTINIMO IŠVADOS**

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**EVALUATION REPORT**  
*OF FINANCIAL AND ACTUARIAL MATHEMATICS (state code -*  
*612G17001)*  
**STUDY PROGRAMME**  
at Vilnius University

**Experts' team:**

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- 2. Prof. Yishao Zhou, *academic,***
- 3. Assoc. Prof. Thomas Hausberger, *academic,***
- 4. Prof. Jonas Valantinas, *academic,***
- 5. Mrs. Aldona Savičienė, *Social partner representative***
- 6. Ms. Dalia Miklaševičiūtė, *students' representative.***

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Išvados parengtos anglų kalba  
Report language – English

## DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Finansų ir draudimo Matematika</i>
Valstybinis kodas	612G17001
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	Pirmoji
Studijų forma (trukmė metais)	Nuolatinė (4)
Studijų programos apimtis kreditais	240
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Finansų ir draudimo Matematikos bakalauro
Studijų programos įregistravimo data	2001-08-02, Nr. 1187

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## INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Financial and Actuarial Mathematics</i>
State code	612G17001
Study area	Physical sciences
Study field	Mathematics
Type of the study programme	University Studies
Study cycle	First
Study mode (length in years)	Full-time (4)
Volume of the study programme in credits	240
Degree and (or) professional qualifications awarded	Bachelor of Financial and Actuarial Mathematics
Date of registration of the study programme	2001-08-02, No. 1187

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## **I. INTRODUCTION**

### ***Background of the evaluation process***

The evaluation of on-going study programmes is based on the **Methodology for evaluation of Higher Education study programmes**, approved by Order No 1-01-162 of 20 December 2010 of the Director of the Centre for Quality Assessment in Higher Education (hereafter – SKVC).

The evaluation is intended to help higher education institutions to constantly improve their study programmes and to inform the public about the quality of studies.

The evaluation process consists of the main following stages: 1) *self-evaluation and self-evaluation report prepared by Higher Education Institution (hereafter – HEI)*; 2) *visit of the review team at the higher education institution*; 3) *production of the evaluation report by the review team and its publication*; 4) *follow-up activities*.

On the basis of external evaluation report of the study programme SKVC takes a decision to accredit study programme either for 6 years or for 3 years. If the programme evaluation is negative such a programme is not accredited.

The programme is **accredited for 6 years** if all evaluation areas are evaluated as “very good” (4 points) or “good” (3 points).

The programme is **accredited for 3 years** if none of the areas was evaluated as “unsatisfactory” (1 point) and at least one evaluation area was evaluated as “satisfactory” (2 points).

The programme **is not accredited** if at least one of evaluation areas was evaluated as "unsatisfactory" (1 point).

### ***General***

The Application documentation submitted by the HEI follows the outline recommended by the SKVC. Along with the self-evaluation report and annexes, the following additional documents have been provided by the HEI before, during and/or after the site-visit:

No.	Name of the document
1.	Action plans
2.	Student publications
3.	Students' practice reports

### ***Background of the HEI/Faculty/Study field/ Additional information***

The study programme of “Financial and Actuarial Mathematics” is implemented by the Department of Mathematical Analysis. The Expert Team had possibility to observe various study

support services (classrooms, computer services, library), as well as to familiarize with students' final works.

The Expert Team conducted also interviews with students. The Expert Team was familiarized with students' attitude towards the study programme. The meeting was carried out in an active and constructive atmosphere. The students expressed positive as well as critical opinions about the programme.

Expert Team met graduates and potential future employers of the students. At the conclusion of the visit, the Expert Team conducted a meeting with staff of the Faculty and highlighted some strengths and weaknesses of the programme.

In the following, the findings of the Expert Team are outlined. The Self-assessment report submitted by the Faculty, the observations made at the time of the visit, and the supplementary material received during the visit form the basis of these assessments.

### ***The Review Team***

The review team was completed according *Description of experts' recruitment*, approved by order No. V-41 of Acting Director of the Centre for Quality Assessment in Higher Education. The Review Visit to HEI was conducted by the team on 27 April, 2017.

1. **Prof. Neda Bokan (team leader)**, *Former Professor of the University of Belgrade, Serbia, Serbia;*
2. **Prof. Yishao Zhou**, *Professor of Mathematics, Department of Mathematics, Stockholm University, Sweden;*
3. **Assoc. Prof. Thomas Hausberger**, *Associate Professor, Department of Mathematics , University of Montpellier, France;*
4. **Prof. Jonas Valantinas**, *Professor at Kaunas University of Technology, Applied mathematics department (Lithuania);*
5. **Mrs. Aldona Savičienė**, *CEO of insurance mediation company UADBB "AM sprendimai" (Lithuania)*
6. **Ms. Dalia Miklaševičiūtė**, *student of Kaunas University of Technology study programme Big Data Analytics (Lithuania).*

## **II. PROGRAMME ANALYSIS**

### ***2.1. Programme aims and learning outcomes***

The aim of "Financial and Actuarial Mathematics" bachelor study programme is to prepare professionals who have fundamental background in pure mathematics and information technologies, together with detailed understanding of demographical, economical, insurance problems, financial risks, and are able to apply theoretical knowledge to solve practical problems as well as to take advantage of thinking abstractly, logically and critically, operating in various professional environments (banks, insurance, companies, etc.), and demonstrating necessary skills to pursue academic careers.

The competences developed and intended learning outcomes of the study programme are

given in proper details and presented in Table 1 (SER, p.7). Competences are separated into two sets in a logically consistent way emphasizing their different role in graduates professions:

- Generic competences: 1. Communication and team working skills; 2. Abstract/logical thinking; 3. Life-long learning skills; 4. Research fundamentals;
- Subject-specific competences: 5. Fundamental knowledge and skills in pure mathematics; 6. IT knowledge and application skills; 7. Applications in Financial/Actuarial field.

The review team concludes the study programme was changed to acquire the requirements of the adoption of the new description of Mathematics study field (especially of Financial and Actuarial Mathematics) approved by the Ministry of Education and Science of the Republic of Lithuania and the objectives correspond with Dublin descriptors and the Lithuanian legal acts.

According to SER the students suppose to acquire knowledge and skills to demonstrate understanding of the main mathematical fields and to apply this knowledge when solving problems, including mathematical reasoning by critically constructing and presenting mathematical arguments, proofs and construct proofs of new simple propositions, related to known results; knowledge of basic IT concepts, specialized software, writing simple codes in a programming language and their application in practice as well as understanding of the core principles of financial and insurance business, including (but not limited to) main laws of micro/macroeconomics, socio-economic and demographic environment, fundamental financial/actuarial principles, models, methods, and choosing appropriate software to solve basic unknown problems, etc.

Abilities to conduct research cover development of skills in problem solving, logical argument, deductive reasoning and analysis, abstraction and generalization as well as locating, retrieving, synthesising, and information from variety of different sources, etc.

Life-long learning skills cover organizing of individual learning and work, time and resources management, including selection of appropriate objectives, methods and tools, individual analysis of study literature, critically reflect on the need for personal improvement, etc.

Expected learning outcomes to acquire abstract/logical thinking are also described and soft skills as well. The programme learning outcomes comply with the requirements of “Description of Mathematicians, Actuaries and Statistician’s Subgroup”.

Consequently, the review team concludes that learning outcomes of this study programme are also in compliance with the Competency Framework for Actuaries, which is employed by Society of Actuaries (USA). As it is written in SER, Study Programme Committee with representatives of Lithuanian Society of Actuaries (LAD) considered the Programme’s syllabus according to existing education requirements employed by LAD. The first cycle programme covers 60-70% of these requirements, and the rest is available including the corresponding master study programme. Finally, this programme and its learning outcomes comply also with the Lithuanian Qualifications Framework describing the first-cycle study programmes of qualifications.

Information on the purpose, learning outcomes, content of the study programme and admission requirements is freely accessible on the Internet, e.g.:

- On the official website of the University intended to prospective students: <http://www.vu.lt/kviecia/>
- On the official website of the Faculty: <http://mif.vu.lt/lt3/stdijos/studiju-programos/ba-studiju-programos> (in Lithuanian)
- On the official website of the “Open System of Providing Information, Tutoring and Vocational Orientation”, or AIKOS (a Lithuanian acronym): [https://www.aikos.smm.lt/paieska/-layouts/15/Asw.Aikos.registerSearch/ObjectFormResult.aspx?o=PROG&f=Prog&key=4405&pt=of&ctx\\_sfbr=sbfr](https://www.aikos.smm.lt/paieska/-layouts/15/Asw.Aikos.registerSearch/ObjectFormResult.aspx?o=PROG&f=Prog&key=4405&pt=of&ctx_sfbr=sbfr)

Every year, University issues a special newsletter intended for the dissemination of information about the first-cycle study programmes “Vilnius University is calling. First-cycle and integrated studies” 9in Lithuanian). Moreover this Study Programme is advertised during the promotional events (for more detail see SER, p.9).

During the meetings with Senior management, social partners and Alumni representatives the review team learned that learning outcomes and subject-specific competencies acquired studying Financial and Actuarial Mathematics are well adopted to the state, societal and labour market needs. Graduates easily find a job in banks, insurance companies, and wherever logical and analytical way of thinking with a proper knowledge of mathematics is necessary. Social partners emphasized the significance of soft skills development, such as problem-solving, ability to think analytically, time and stress management, etc. Majority of these skills are acquired during the study and others might be developed through the career centre of the Vilnius University.

There exists a good cooperation with the Lithuanian Actuarial Society which implies proper changes of learning outcomes and skills in financial and actuarial fields as well as strengthens of IT skills in the study programme. Recognizable results of cooperation with social partners are regular consultations in bachelor thesis choice and its preparation, good organization of internship to acquire practical skills in financial/actuarial field important in business. Stakeholders have shown an interest to develop skills of model society creation (e.g. insurance, etc.) and the development of life-long learning competences through common seminars of stakeholders and teaching staff to exchange information important for personal improvement and the study programme. The senior management informed the review team in the frame of the reorganization of the Vilnius University there exists an action plan how to improve the feedback of students opinion how to improve learning outcomes of the study programme.

Programme objectives and intended learning outcomes correspond to the mission, operational objectives and strategy of the Vilnius University.

Upon completion of the Study Programme graduates may engage in further studies at the Master’s level in Financial and Actuarial Mathematics, Statistics or Economics, or successfully work as actuaries, financial analysts, consultants in the financial/insurance sector (insurance companies, pension/investment funds, etc.) and/or in public organizations, such as health care and social security and also in every area where general financial and risk management skills are required.

The review team concludes that the recommendations of previous external evaluation is taken into account and the title of the programme, the learning outcomes and the content are now adjusted so that they are mutually compatible.

## ***2.2. Curriculum design***

The curriculum design is in line with the Lithuanian legal acts regulating the structure of study programmes. More precisely, the programme comprises (i) 240 ECTS credits (four years of study), (ii) 180 credits within the study field, (iii) 15 credits on general university studies, (iv) 15 credits internship, (v) 15 credits for preparation of final bachelor’s thesis, (vi) 30 credits of students own choice of courses offered by the university and (vii) there are 6 courses per semester.

The curriculum has been undergoing a big revision and improvement to meet recommendations from the 2015’s review. The review team is satisfied with the effort made thus far in relatively short time period and could conclude that the following aspects are satisfactory: The subjects of study are taught in a consistent manner, and topics are not repeated in general; the content of subjects corresponds to the first cycle of studies in mathematics; both the content of subjects and study methods enable to achieve the intended learning outcomes; the scope of the programme is sufficient to achieve the learning outcomes; and the content of the programme corresponds to the latest academic achievements.

More analysis on the revised curriculum corresponding to the last review is given below. The balance between pure mathematics and applied subjects is more satisfactory than that the programme started. The IT is integrated in some courses or provided as an optional course in the later years of the education, although the review team believes that there are more opportunities to integrate computer programs in many courses including less applied subjects. It requires a little innovative idea. To some extent one has to take out some material to make working load reasonable. It is also an improvement that the group work is emphasised more than before. From the site visit it confirms that the group work is more and more involved in teaching and study methods although it is still could be improved. From the site visit it confirms that the group work is more and more involved in teaching and study methods although it is still could be improved. It should be pointed out that thesis group work is still allowed but with a declaration of contribution from each of the students. The current review team believes, as previous evaluation, that (independently) individual thesis work is an important component in higher education. It is challenge for all young students, especially the future employers anticipate such a competence.

An overall impression of the curriculum is positive, especially with the current development. It prepares students for the labour market with solid mathematics and broad education in financial mathematics and insurance mathematics and social contact networks.

Since this study programme is designed with an eye on future labour market, it requires knowledge from social science and law. However the review team could find neither any compulsory course in law nor courses that can enhance students' ability on mathematical communication. On site-visit the review team observed that students felt the shortness of knowledge in general philosophy in their later studies but too young to recognize it when they just entered the programme.

### ***2.3. Teaching staff***

There are 25 academic staff members engaged in the programme: 8 Professors (Dr Habil. Or Prof. Dr.), 6 Associate Professors (Dr), 8 Lecturers (Dr) and 3 Assistant Lecturers. The staff is stable and experienced with an average teaching experience of around 20 years. The average students-to-teachers ratio during the evaluation period is 8.5.

The teaching staff meets the legal requirement with 36 out of 38 course units being taught by researchers. The fields of expertise of the teachers presented in the annex 2 of the SER are not detailed beyond the distinction Physical Sciences / Social Sciences. This should be clarified in future evaluation processes. The CVs given in annex 3 allowed to identify that the fields of expertise covers mathematical domains in pure mathematics (Analytic Number Theory, Probability Theory) and applied mathematics (Mathematical Modelling, Computational Modellings, Statistics, Risk Theory and Actuarial Mathematics) and therefore assess competencies globally adequate to achieve the list of learning outcomes stated in the programme description. Nevertheless, competencies in Algebra and Geometry need to be reinforced to fully reach the 5<sup>th</sup> learning outcome related to fundamental knowledge in pure mathematics, as the interviews allowed to confirm that there is currently no specialist in Algebra nor Geometry (a researcher with competences in these fields attested by publications in the international standards) among the teaching staff. Some lectures are given by professionals in order to strengthen the professional dimension of the programme, which is very positive and important to create a good match between learning outcomes, professional skills and labor market needs.

Although the teacher-student ratio is acceptable, the very high number of students (163) induces a potential problem of staff shortage regarding the supervision of graduation theses. It became apparent from the interviews and the examination of samples of such theses that this is compensated by group-work in teams of 1-3 students, with an average of 2 students per thesis. Communication with SPC confirmed that SPC admits bachelor thesis should be prepared on individual basis and measures are taken in this direction. During spring 2017, 23 students



prepared their thesis on an individual basis and 20 in pairs, thus reducing the average number of students per thesis to 1,3.

The international recognition of the research carried out by the main part of staff members is acknowledged by scientific publications in international journals, the participation in international conferences and also the organisation of international conferences such as the 11<sup>th</sup> International Vilnius Conference on Probability Theory and Mathematical Statistics.

The pedagogical professional development of teachers is encouraged by the university policy through the participation in various courses focusing on pedagogy and the use of ICT in teaching, in relation to the creation of the Vilnius University Pedagogy Center. Nevertheless, the interviews permitted to clarify that this training program was currently suspended due to the restructuring of the university. In fact, very few teachers attended these seminars, partly due to their focus on secondary education. A proper plan of professional development for university teachers should include seminars in the didactics of the scientific disciplines adequate to transfer to teachers the results of the international research in education at the tertiary level and in particular the didactics of mathematics.

The training proposed by the Vilnius University Pedagogy Center did not cover content-specific issues in the teaching and learning of mathematics (e.g. the secondary-tertiary transition in relation to mathematics, the transition from calculus to analysis, the issues of abstract subjects such as linear algebra, the epistemology of mathematical models, etc.). It was discovered during the meeting that this may be explained by a lack of researcher in the didactics of mathematics. It may be worth hiring an experienced researcher in University Mathematics Education (UME), or at least give volunteering staff members the opportunity to attend international conferences in this field. These teachers may, after suitable training, contribute to the international research in UME and organize locally seminars on university pedagogy and didactics. Initial teacher training of PhD students and young doctors should be systematically encouraged.

The current representation of age bands (equal representation of bands 35-44, 45-54 & 55-64) offers a balanced picture that is favorable to the programme and its future development. Since 2013 at VU, the teaching and research staff is recruited and promoted on the basis of the result of an open competition. This could be a very positive measure for research and teaching at VU, if the open calls are set up as to potentially attract the best researchers from Lithuania and other Baltic and neighboring countries. Together with the current salary reform, it would give the best chances to fill any potential staff shortage in the programme in the years to come. Unfortunately, it was discovered during the interviews that the calls are not open in practice, since a candidate is most of the time in mind when the position is proposed, and the positions are not advertised as broadly as possible through the existing academic networks. Indeed, positions were advertised for the first time in 2017, at the website of Lithuanian Science Council. Communication with SPC confirmed that SPC and VU Faculty are aware of the necessity of setting up a proper plan of recruitment based on more open calls.

VU is currently working on the issue of the teachers' overload of teaching hours that needs to be reduced to guarantee decent research conditions as required by law. But the interviews made it clear that this reduction is still uncertain. The envisaged distribution of teaching loads varies from 384 contact hours / year for lecturers to 224 contact hours / year for professors. In comparison, the current situation, as asserted during the interviews, amounts to about 500 contact hours / year (10-14 hours / week) for a professor and about 900 hours / year for a lecturer. The external expert teams stresses that this number of contact hours should be reduced to meet the international standards of about 200 contact hours / year for a professor. It should also be pointed out that 384 h doesn't give a lecturer decent conditions for professional development as a researcher. In order to guarantee the provision of the programme, lower contact hours should be offered to lecturers who are planning for professorship. Moreover, it was also discovered during the interviews that a great number of teachers, and especially young doctors, only teach half-time as they need to take a second job to compensate low salaries in the academic carriers. This situation certainly affects the research outcomes and explains the low

mobility of the teaching staff (international mobility is limited to short stays on the occasion of conferences or workshops, a single staff member went abroad for a teaching visit). This situation should be improved and the international mobility of the teaching staff should be encouraged and developed.

#### ***2.4. Facilities and learning resources***

The lectures of study programme takes place mainly in two buildings: Naugarduko St. 24 (classrooms and teacher's offices) and Šaltinių St. 1A (computer laboratories). But students have optional courses at the Didlaukio St. Building, and general university courses (GUS) at the other university facilities, depending on their choice.

There are 17 classrooms (total number of seats 983), 6 computer laboratories (total number of seats 157). The building at Didlaukio St. was renovated, and 8 new computer classes were installed. The three largest rooms in the Didlaukio St. building are equipped with remote control cameras for online broadcasting of lectures for disabled students.

Classrooms for lectures are equipped with blackboards and projectors. Bigger lecture rooms are all equipped with laptops, projector, sound system, computer for presentations. In the laboratories students may work on different operating systems. Wireless internet connection is available in all Faculty buildings. Students and staff can use EDUROAM or MIF open wireless connection, can also use the supercomputer<sup>21</sup> located at the Faculty of Mathematics and Informatics for scientific research purposes or educational activities free of charge. Vilnius University Centre of Information Technology Development provides various core IT services for staff and students. Vilnius University E-learning and Examination Centre provides Virtual Learning Environment for lecturers and enables examination of large groups of students simultaneously in large computer classes in Saulėtekio St. buildings.

The Internship are carried out at financial institutions (banks, insurance companies, audit companies) and other non-financial sector enterprises. The internship is an opportunity for the students to apply knowledge in practice, develop essential skills and competencies according to the employees needs, and finally the training institution serves a bridge to get a permanent employment position.

The premises for studies are sufficient for successful studies as well available software and computer equipment meet teaching and learning needs.

The Faculty library owns around 70.000 various resources and publications on mathematics, statistics, probability theory, economics, informatics, information technologies, and other subjects in different languages, mostly in English and Lithuanian. The students and the academic staff have access to the Central Vilnius University library and the library of the Lithuanian Science Academy. The budget spent on Faculty library resources renewal decreased in year 2015/2016 due to the fact that students started using more often electronic resources, such as electronic books, databases. There is a library reading room in Naugarduko St. with 90 seats (8 of them with computers). Students can also use the resources and self-study environment at the new modern Vilnius University library (MKIC) located at Saulėtekio St. 5, open on a 24/7 basis and close to dormitories.

There are possibilities to use Vilnius University Virtual Learning Environment (based on Moodle). Teachers use Moodle as a supplement to face-to-face communication. Other teachers usually also use some platform for virtual communication.

Teaching materials and technical resources (textbooks, books, periodical publications, databases) are sufficient and accessible. The premises meet the safety and hygiene norms requirements. The Faculty is currently being renovated to make it more accessible for people with disabilities; their needs are prioritized when conducting a timetable - all lectures with disabled students are usually planned on the ground floor, so that they have an easy access to the

rooms.

## ***2.5. Study process and students' performance assessment***

The admission requirements in the Financial and Actuarial Mathematics programme are clearly elaborated and they follow all requirements applied for the 1st cycle studies at the VU and are laid out according to the Senate-prescribed Rules of Admission to the Study Programmes of the Vilnius University. The competition score for entering the programme is correctly elaborated and is in accordance with the formula prescribed by the admission rules. As stated in SER, the entrance score is based on the results of some school subjects and the Matura examinations. The Matura examinations considered for the entrance score are the following: School-leaving national exam in Mathematics (weight - 0,4), School-leaving (but not necessarily national) exam in Lithuanian Language and Literature (0,2), School-leaving (but not necessarily national) exam or final school grade in Information Technology or Physics(subject depends on applicants choice) (0,2), One more subject taught in secondary school and different from those listed before (0,2).

It is remarkable that VU introduced an additional requirement that the minimum score for entering this programme should be not less than 4 which is a quality standard for university entrants. Nevertheless, all the entrants exceeded this requirement as the lowest score was 4,9. The general trend in Lithuanian HEIs is that the number of students is decreasing. Nevertheless, the programme does not face with significant changes in the number of the admitted student (2014-53, 2015-58, 2016-61. The increasing numbers prove that the programme should be considered as popular by students and sustainable.

Although the entrance score of students does not decrease dramatically during the recent years (7,78 in 2014, 8,01 in 2015 and 7,51 in 2016) and it exceeds the mean value of the other programmes in the faculty, but it is highlighted that the gap between the best and the weakest students is increasing, for instance in 2014 the largest score was 9,8 and the lowest score was 4,94 for state funded place while in 2016 the largest score was 10,86 and the lowest score was 4,90 for the state funded place. The mean value of non-state funded places is even lower. This could increase the risk of not reaching all expected learning outcomes for every student in the programme.

The programme management takes into account the complexity of the study programme and analyzes the dropout rate. The average graduation rate in the programme is 73% during the period 2012-2016 which is between the acceptable limits. Nevertheless, the majority of dropouts appear in the first year of studies, hence the programme management should take additional means to reduce the dropout rate during the first year of studies. The reasons for the drop outs consist of inability to maintain adequate academic standards and students own will which raises the risk of the mismatch between programme management and students expectations.

The general rules for the assessment of students' achievements are clearly elaborated in the faculty and VU. Students are well-informed about all requirements they have to follow during the study process as well as appealing procedure. At the beginning of each course, students are introduced to the module description, learning outcomes and the upcoming learning process. The feedback culture is also being established in the programme as students are able to fill in the questionnaire at the end of the semester. Nevertheless, the questionnaire is not actively used by the students due to the large number of questions and lack of feedback after the changes are implemented in the programme. Although programme management is changing the questionnaire for student's feedback as well as using additional methods such as Moodle surveys or recommendations in the groups, it is also suggested having more face to face conversations with the students during each module for instance Focus groups.

The faculty also stresses out the need of individual consultations and additional lectures for the students, hence the extra-curriculum course on Mathematical Analysis (one of most

difficult subjects for students) is being offered. This initiative is considered as positive by the experts, keeping in mind the growing needs of individual plans for each student in the future.

The students of this programme have the possibility to get variety of support such as career development, job openings, psychological assistance, accommodation, cultural activities etc. Additionally, students are able to receive different types of financial support such as special grants for academic excellence, social grants, single social allowances and single special social allowances. Additionally, the faculty encourages students to get interested into research activities. One of the examples to attract the most talented students is a new optional course of Scientific seminar which is available (recommended) for the brightest students who want to acquire additional research skills. Some of the students also used the opportunity to publish articles (usually based on bachelor theses) in scientific journals.

The faculty encourages students to participate in international mobility while using Erasmus+ opportunity. Students are aware of such opportunity but usually decline the offer regarding the financial reasons or they are already employed. Nevertheless, there is no evidence of exchange students coming to study in this programme which would be a great asset for current students to increase the internationalization and intercultural skills. Additionally, the faculty should consider more subjects taught completely in English or inviting guest lecturers from abroad as students feel the need to improve their communication in English skills in order to be more competitive in the market.

Procedures for the preparation and defence of a bachelor thesis are clearly stated in the Procedure for the Preparation, Defence and Safekeeping of Graduation Theses. Program Committee took in to account the recommendation from the previous experts and starting from 2015, students are advised to prepare graduation thesis on individual basis but there are still many theses which are prepared in pairs. It is remarkable that social partners are also included into the defence committee to provide additional opinion on the theses presented. Although the requirements and the process of the Bachelor thesis is clearly stated and students are satisfied, the potential of the stakeholders as a source of master thesis topics is not sufficiently used. During the meeting with the stakeholders, the majority of representatives admitted that they could suggest practical topics for the students.

The faculty is also taking measures to increase academic honesty. It is working according to the Code of Academic Ethics of Vilnius University, which defines general norms of academic, teaching, studies and research ethics. The students are familiarized with this document and have to adhere to the principles stated in it.

According to SER, the employability rate is very high as students enrolling in this programme already have jobs and want to deepen their knowledge. The examples of occupations for this programme graduates consist of financial analysts, Mathematician, Actuary or Statistician, accountant etc. The most recent graduates are switching their careers to the IT related occupations as there is a high demand of their kind of specialists in Lithuania. The graduates of this programme are highly valued by the stakeholders who employ the students during their studies for internship and full-time jobs.

## ***2.6. Programme management***

The study programme's implementation is administered by the Department of Studies, which is also responsible for ensuring the quality of studies at the University. 'VU Quality Manual' is the main document concerned with internal quality assurance of studies. In the self-evaluation report, the whole list of actions, priority steps and procedures (regular training courses for promotion of the teaching staff, courses oriented to make the virtual learning environment more attractive, etc.), which monitor implementation and improvement of the programme, is presented clearly and in detail. In this context, responsibilities among various subdivisions of the University (Faculty) and respective individuals are highlighted sufficiently.

The quality of the programme is assured through its internal evaluation and external

assessment. The Study Programme Committee (SPC) accumulates and analyses data about the programme, monitors feedback from students and graduates (twice a year, with the averaged activity rate 78%, from 2012 to 2016) and makes preliminary decisions which, later on, are approved by the Faculty Council. Social partners (Bank of Lithuania, Danske Bank, ERGO, etc.) are in close cooperation with SPC. Many facts on their participation in delivering lectures to Financial and Actuarial Mathematics students and/or organizing internships, as well as in the programmes' monitoring process itself are significant and praiseworthy.

A wide spectrum of measures (surveys, seminars and task-oriented formal discussions for stakeholders, highly effective activities of Feedback Group, Q&A system, etc.) are put into practice and give appreciable results. For instance, the recent survey of major employers of the programme's graduates (organized with the help of Lithuanian Actuarial Society; 2017) has led to the introduction into the syllabus of a new subject "Financial Reports and Their Analysis", which has also enlivened gaining of students' communication skills. The programme's administrators conduct regular research on the career possibilities and employability of graduates, the employers' opinion how well graduates' knowledge and skills meet labour-market needs. Summarizing, the study programme's aims and expected learning outcomes are received practically by the Faculty (University) boards and individuals, including stakeholders, via properly-tuned actions, meetings and discussions.

Taking into consideration the previous external assessment results and recommendations (2014), some serious and efficient changes, concerning the syllabus, preparation of Final thesis, etc., have been made in the programme. In particular, to make the syllabus more "smooth", a new study module "Introduction to Financial and Actuarial Mathematics" (1<sup>st</sup> semester) was implemented, impact on IT (2<sup>nd</sup> semester) was done. Also, serious revision of the learning outcomes of the programme, focusing on needs of modern labour market, was carried out.

The Faculty community (students, teachers, etc.) have good access to data recourses and information on the study process and monitoring of the programme. In particular, official websites of the University and Faculty (with direct access to the University Information System), AIKOS, Discovery Days, Study Fair, the annual newsletter, University booklets and so on. Summarizing, availability and transparency of the information is maintained at a proper level.

According to the self-evaluation report, Faculty administration has no problems with yearly enlisting of newcomers to the programme. Undoubtedly, this is a consequence of an efficient and proper administration of the programme.

Exceptionally solid theoretical background of the programme; the internal quality assurance measures are attractive, efficient and well-organized; availability of information about the programme and its improvements is handy and praiseworthy.

## **2.7. Examples of excellence \***

The competences developed and intended learning outcomes of the study programme are given in proper details. Competences are separated into two sets in a logically consistent way emphasizing their different role in graduates' professions:

- Generic competences: 1. Communication and team working skills; 2. Abstract/logical thinking; 3. Life-long learning skills; 4. Research fundamentals;
- Subject-specific competences: 5. Fundamental knowledge and skills in pure mathematics; 6. IT knowledge and application skills; 7. Applications in Financial/Actuarial field.

### III. RECOMMENDATIONS\*

1. It is recommended to promote team work in regular courses and ensure that the thesis work is done on an individual basis to develop scientific autonomy and sense of responsibility.
2. The review team recommends to reconsider the course in Law as a perspective course for those who choose actuarial mathematics as speciality for international actuary certification.
3. The review team also recommends to reconsider the course Philosophy as a perspective course in the block of 15 credits of general university courses. Alternatively, a course on mathematical communication that covers topics from general philosophy, epistemology and didactics of mathematics may be introduced in order to train students to reflect on scientific activity and communicate with different target groups.
4. Competencies in Algebra and Geometry should be reinforced to fully reach the 5<sup>th</sup> learning outcome related to fundamental knowledge in pure mathematics. Teachers from abroad may be recruited in the frame of the Erasmus program before candidates are found to be hired as professors in VU in these fields.
5. The number of contact hours should be limited to approach the international standard of 200 contact hours / year and therefore guarantee research conditions of staff members for the viability of the graduate study programme.
6. International mobility of the teaching staff should be encouraged through exchange programmes, taking advantage of the possibility of a sabbatical. Initial teacher training of PhD students and young doctors should be systematically encouraged. This training shouldn't restrict to general pedagogical concerns and ICT skills but also include an opportunity for reflective thinking on the teaching and learning of mathematical topics.
7. The level of internationalization of the programme should be enhanced by increasing the mobility of students and academic staff as well as introducing additional international activities.
8. The content and the requirements of the internship report should be enhanced as students see it just as a formal paper work.
9. The study programme should be subjected to regular observations in order to make it even more up-to-date and attractive.
10. Project-based and case study teaching methods, as well as group work should be developed and applied on a regular basis in the study process. It would "soften" the gap between theory and practice, which is noticeable at the moment.

#### IV. SUMMARY

The aim of “Financial and Actuarial Mathematics” bachelor study programme is *to prepare professionals who have fundamental background in pure mathematics and information technologies, together with detailed understanding of demographical, economical, insurance problems, financial risks, and are able to apply theoretical knowledge to solve practical problems as well as to take advantage of thinking abstractly, logically and critically, operating in various professional environments (banks, insurance, companies, etc.), and demonstrating necessary skills to pursue academic careers.* The competences developed and intended learning outcomes of the study programme are given in proper details. Competences are separated into two sets in a logically consistent way emphasizing their different role in graduates professions:

- Generic competences: 1. Communication and team working skills; 2. Abstract/logical thinking; 3. Life-long learning skills; 4. Research fundamentals;
- Subject-specific competences: 5. Fundamental knowledge and skills in pure mathematics; 6. IT knowledge and application skills; 7. Applications in Financial/Actuarial field.

The synergy of demanding students, programme management and teaching staff is exemplary for a good implementation of the study programme. Lecture notes are given in advance through Moodle platform yet well articulated with classroom inputs, as attested by a high attendance rate of the students. The programme has a good number of enrolled students and offers a coherent study opportunity for students, since the bachelors lead to the master programme which in turn responds to the need of the labour market.

The fields of expertise covers mathematical domains in pure mathematics (Analytic Number Theory, Probability Theory) and applied mathematics (Mathematical Modelling, Computational Modellings, Statistics, Risk Theory and Actuarial Mathematics) and therefore assess competencies globally adequate to achieve the list of learning outcomes stated in the programme description. Nevertheless, competencies in Algebra and Geometry need to be reinforced to fully reach the 5<sup>th</sup> learning outcome related to fundamental knowledge in pure mathematics, as the interviews allowed to confirm that there is currently no specialist in Algebra nor Geometry (a researcher with competences in these fields attested by publications in the international standards) among the teaching staff. Mobility of teaching staff and students is still insufficient.

The workload of teaching staff in education and research activities are not balanced. Therefore it is uncertain that the reform of the Vilnius university will be successful in these circumstances.

## V. GENERAL ASSESSMENT

The study programme *Financial and Actuarial Mathematics* (state code – 612G17001) at Vilnius University is given **positive** evaluation.

*Study programme assessment in points by evaluation areas.*

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	4
2.	Curriculum design	3
3.	Teaching staff	3
4.	Facilities and learning resources	3
5.	Study process and students' performance assessment	3
6.	Programme management	4
	<b>Total:</b>	<b>20</b>

\*1 (unsatisfactory) - there are essential shortcomings that must be eliminated;

2 (satisfactory) - meets the established minimum requirements, needs improvement;

3 (good) - the field develops systematically, has distinctive features;

4 (very good) - the field is exceptionally good.

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