



STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Šiaulių universiteto
**STUDIJŲ PROGRAMOS *FINANSŲ MATEMATIKA* (valstybinis
kodas - 612G17002)
VERTINIMO IŠVADOS**

**EVALUATION REPORT
OF *FINANCIAL MATHEMATICS* (state code - 612G17002)
STUDY PROGRAMME
at Šiauliai University**

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DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	<i>Finansų Matematika</i>
Valstybinis kodas	612G17002
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinės studijos
Studijų pakopa	Pirmoji
Studijų forma (trukmė metais)	Nuolatinė (3,5)
Studijų programos apimtis kreditais	210
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Finansų ir draudimo matematikos bakalauras
Studijų programos įregistravimo data	2012-04-04

INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	<i>Financial Mathematics</i>
State code	612G17002
Study area	Physical sciences
Study field	Mathematics
Type of the study programme	University Studies
Study cycle	First
Study mode (length in years)	Full-time (3,5)
Volume of the study programme in credits	210
Degree and (or) professional qualifications awarded	Bachelor of Financial and Actuarial Mathematics
Date of registration of the study programme	4th April, 2012

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The Centre for Quality Assessment in Higher Education

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I. INTRODUCTION

1.1. 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).

1.2. 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.	Feedback forms
2.	Examination material

1.3. Background of the HEI/Faculty/Study field/ Additional information

This report summarizes the observations of the expert team based on the analysis of documents prepared by the self-assessment group consisting of experts of Šiauliai university (SU) and the information obtained from the interviews during the visit at the SU. The members

of the Team acquainted themselves with and assessed the documentation and annexes provided by the Lithuanian Centre for Quality Assessment in Higher Education (CQAHE) in Vilnius.

The Team would like to thank the authorities of SU for their friendly welcome and hospitality. We also want to express our appreciation to the various representatives of SU who actively participated in the meetings and considerably contributed by their open discussions to a good overview of the institution.

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 25 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 bachelor study programme "Financial Mathematics" is *to educate students in financial and insurance mathematics to be capable of combining the acquired and integrate new fundamental knowledge of mathematics, interdisciplinary financial, insurance and information technologies for the formation and development of competences necessary for interdisciplinary studies, scientific research or professional (of actuary, finances, and/or operations research analyst, insurance specialist activity).* These objectives correspond with Dublin descriptors, the description of the Lithuanian legal acts and cover knowledge and its application, research skills including special abilities and soft skills of social and personal types. According to SER the formulated intended learning outcomes of the Financial Mathematics study programme students suppose to acquire knowledge of the concepts, definitions, theorems and laws of the basic mathematical areas. Also to apply them in complex and creative way formulating, solving and substantiating the solutions of theoretical and/or practical tasks and problems; knowledge of classical analytical, numerical, probabilistic and other mathematical methods, as well as the algorithms and their applications, especially using mathematical software; knowledge of mathematical modelling algorithms in professional activity; knowledge of essential theories, laws, indicators, and methods in economics, finance, and insurance (to combine and integrate them) and knowledge of the basic principles of algorithmization and programming, creation of data bases, use of business intelligence systems, work in networks, information retrieval and data protection.

Abilities to conduct research cover findings, critical selection and systematization of scientific and professional literature to apply it while performing study tasks, to solve research problems and/or to conduct professional activity as well as collection and process data to analyze, assess and interpret research results; analysis and formalization of the real phenomena and processes of indicated context in economic and financial situation, using modelling methods, etc. Special abilities important for operating with mathematical symbols, terms, abstract concepts, construction and proofs of new statements, applications of known mathematical methods (Econometrics, Time Series, Actuarial Mathematics, etc) in solving of certain tasks in real processes 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”: mathematicians, actuaries and statisticians conduct science research works, create, prepare and improve the theories, conceptions, methods and models of mathematics, insurance and statistics; they apply this knowledge in solving the tasks of different spheres (engineering, social and other sciences). The compliance of learning outcomes with the requirements for the mentioned professional activities is presented in SER report in table 2 and Annex 6.

Programme aims and intended learning outcomes are published on the websites of AIKOS. The information is available on the University website <http://www.su.lt> and website www.studijos.lt.

Objectives and learning outcomes concerning interdisciplinary research are involved according to the ideas of business representatives from companies “Affecto Lietuva”, “Omnitel”, and the initiative of Šiauliai Industrialists Association. The discussions with social partners created the conditions to formulate relevant and real learning outcomes necessary for the solution of problems of financial management, emphasizing the development of the competences of data search, protection and processing.

This programme was registered in 2012 in the scope of 240 ECTS and had not been evaluated by external experts. In the scope of 210 ECTS has been implemented only two academic years. All competences and learning outcomes are formally well described in general terms, such as “...the concepts, definitions, theorems and laws of the basic mathematical areas, ability to select them, ...” (see SER, p. 7, Table 2), publicly announced, though very ambitious for 210 ECTS credits. It would be necessary to reconsider them and write in a more appropriate form, especially emphasizing the acquired knowledge and its applications which characterize this study programme among others.

During the meeting with employers and social partners the review team have recognized their well developed cooperation with Šiauliai University. Two events every year are organized to exchange experience in using of IT and mathematics in sustainable development of region. Among aims of this cooperation is also consideration of necessary competences acquired in study programme and their improvement as well as corresponding learning outcomes. Social partners informed review team that graduates achieve well-chosen subject specific competences in financial mathematics. Moreover, graduates acquire problem solving skills, logical way of thinking and hence they know how to find information quickly. Students are able to solve some problem quicker, simpler, by using optimized procedure.

Representatives of Alumni organization have emphasized a proper feedback of their recommendation to prepare this study programme having in mind weaknesses of the previous bachelor study programme in Mathematics. Consequently, graduates acquire: creative way of thinking, abstract way of thinking developed through good examples and motivation to generalize some results in a formal way, subject specific skills in line with labour market redundancy, especially of the region, as well as pedagogical abilities of 60 ECTS (as additional professional requirement for school teachers). An involvement of students in the Šiauliai University’s Senate, the Study Programme Committee, etc. help them to develop project leader, team leader skills as well as teaching/learning methods help to achieve presentation skills.

Concerning these previously mentioned opinions and analyzing SER the review team judges that programme objectives and intended learning outcomes are linked to the state, societal and labour market needs.

Programme aims comply with the University mission (see Šiauliai University Strategy <http://www.su.lt>) by the activity of international level science, arts and study innovations to promote regional and national advancement, as well as “Šiauliai City Strategic Development Plan, 2015-2014“ – to educate public awareness, citizenship, to promote collaboration of business, education, NGO, culture and science.

Programme objectives and intended learning outcomes are linked with academic and professional requirements. The programme is designed so that conditions would be created for students to acquire subject-specific (theoretical and practical) knowledge, to understand the possibilities of its application in academic and practical activity. Consequently, graduates of this programme may engage in further studies at the master level in mathematics, financial and actuarial mathematics, and/or statistics in national and foreign universities, as well as to develop the career with the following professions: financial managers, financial and insurance services division managers, financial analysts, credit and loan specialists, statisticians, mathematicians, etc. During the meetings with Alumni and social partners the review team have learned that graduates can develop a career in the schools if they acquire additional pedagogical abilities of 60 ECTS at the University.

To increase the possibilities for students to join the international exchange programmes intended learning outcomes were prepared taking into account the study programme Actuarial-Financial Mathematics (University of Aegean, Greece) and the study programme Financial Mathematics (Kent State University, the USA).

The level of complexity of learning outcomes complies with the requirements raised for study programmes awarding university Bachelor's degree: a student acquires competences necessary for first cycle Bachelor's qualification degree corresponding to the sixth qualification level according to the levels of European and Lithuanian national qualifications frameworks.

The title of the programme, intended learning outcomes, the content of the programme and the qualification to be obtained are well-tuned. Having in mind analysis presented above, it would be important to reconsider competencies and learning outcomes and write in a more appropriate form, especially emphasizing the acquired knowledge and its applications which characterize this study programme among others.

2.2. Curriculum design

The Bachelor programme in Financial and Actuarial Mathematics is a full-time study programme with 3,5 years in duration, in first cycle of higher education. It covers 210 ECTS credits. The programme includes 15 credits in general university subjects, 174 credits in study field subjects and 21 credits in student's elective subjects. Within the programme 15 credits are dedicated to practices and 15 to Bachelor's thesis. The number of study subjects per semester is 6 or 7 and 3 in the last semester. Therefore the programme structure is in line with the legislative requirements.

The programme covers basic courses in mathematics such as algebra, mathematical analysis, probability theory, complex analysis, differential equations and numerical analysis, etc. as well as basic subjects in financial mathematics and insurance mathematics. Thus the content of subjects corresponds to the first cycle of study in financial mathematics.

The courses in fundamental subjects are taught in a more traditional way such as lectures, classroom practice and tutorial while more applied subjects are taught with less lectures and more laboratory work. Case study, problem-based teaching is successfully introduced in more advanced level of courses. Thus the subjects are taught, in general, in a consistent manner. However the review team found certain overlaps in the elective courses *Methods of Optimization* and *Operations Research*, especially they belong to the same elective study block. There exist

also certain overlaps in the courses *Applied mathematics software* and *Programming in Computer Algebra Systems*. It is recommended to eliminate the overlap as much as possible.

Courses such as *Financial Computations*, *Programming in Computer Algebra Systems*, *Corporate Financial Management/Risk Management*, *Life Insurance*, *Mathematical Modelling and Analysis*, *Stochastic Processes in Financial Markets* etc. provide a good ground for realization of the learning outcomes. The review team observed that the programme has implemented a row of non-traditional teaching and study methods in order to achieve expected learning outcomes. From the teaching side, individual and group work is applied and the creative tasks are assigned in the theoretic topics. A combination of campus and distance learning is used to increase the contact possibilities with students. When students enter more advanced courses they are required to do more individual work and interactive lecture and problem-based methods, aiming to stimulating critical and logical thinking and creating a possibility to develop both research competencies and subject-specific abilities. These contribute to better achievement of expected learning outcomes.

To some extent the optimality of scope of 210 credits, the minimum credits possible for BA in Lithuania, is questionable. In this case the anticipation is very high; students have to take 6 or 7 courses each semester for three years. It is well-known that a tight study schedule could often be contra productive with regard to creativity in problem solving and creative thinking. Here the emphasis should lie on creative thinking outside solving classroom or textbook problems and on students' own reflection on what they have learned and what kind of real problems they are able to deal with. This is not possible just by increasing the amount of study possibilities such as distance learning or personal assistance in classrooms. This is particularly important for this study programme due to the nature of the subjects and expected future labour market. Creative thinking can only come from a mature individual if sufficient time is given. And maturity cannot be taught by shortening the study period. Moreover, the student-working load is very heavy in comparison with international standard, where a shortened study duration is devoted to a few exceptional excellent students, not a standard study programme for a general mass. Therefore it is questionable if the scope of the programme is completely sufficient to achieve the learning outcomes at a satisfactory level.

It is worthwhile pointing out that turning from the current 240 credits system to the European standard of 180 ECTS is not a simple number conversion. It requires careful strategies and structural change in a curriculum design.

Since financial mathematics is qualified itself as a recent development the review team concludes that the content of the curriculum corresponds to recent academic achievements. The content of the course *Applied mathematics software* used in some courses corresponds to recent software development.

According to the SER the programme aims at training students towards highly qualified specialists within mathematical finance and insurance. Graduates from the programme are expected to be "able to work in different profile institutions of finances or insurance and their maintenance, logistics, business, enterprises, public sector, research centres or in other spheres requiring mathematical preparation and analytical thinking, as well as to study in Master studies in the fields of mathematics, statistics or economics". The review team found that it was hard to draw conclusion along these lines since there is hardly large enough statistics to prove or disprove the statements detailed above. However, during the site visit the review team noticed that the graduates and the social partners backed up at least partially these conclusions. It is worth pointing out that SER does not provide weakness in terms of programme design. Thus it is hard for the responsible people or organization to improve the curriculum design if weakness is not recognized.

Note that the faculty is strong in theoretical and some fundamental subjects. The programme should consider this as strength. Currently the study programme is not able to fully

rely on this strength to educate the mathematical mature students due to study duration of 3,5 years with ambitious learning outcomes. If there would be 6 more months the students would have more chances to digest theory and to learn how to deal with for example complicated data in reality in a systematic way. The review team's impression on shortness of the study time coincides with the graduates' experience of some handicap feeling in a systematic way of dealing with data. Thus the review team strongly recommends that SU reconsider the duration of the study programme.

If possible it would be also an improvement for the study programme to include a basic course *theoretic treatment* in the line of machine learning or data mining due to the fact that the review team believes that it will benefit students facing and dealing with real-time large quantity of data when they are confident in theoretic understanding of data and their structures. Again it needs more time to have such a possibility.

2.3. Teaching staff

There are 25 academic staff members engaged in the programme: 7 Professors, 10 Associate Professors, 5 Lecturers and 3 assistants. The staff is experienced with an average teaching experience of about 18 years. The teachers-to-students ratio was 2.21 in 2015-16 with 15 admitted students in total for the 3-years study programme, which is favourable to the programme and may be explained by the fact that a majority of study subjects are taught by different staff members.

The teaching staff is meeting the legal requirement with 72% of staff having a doctorate title in sciences. The fields of expertise of the teachers covers mathematical domains (Number Theory, Probability Theory, Statistics, Differential equations, Computational modelling), Informatics (Algorithmics, Databases and data mining), Economical sciences, Philosophy of science, Languages. This expertise is coherent with the content of the taught courses, on the individual level, and it globally ensures qualifications adequate to achieve the learning outcomes regarding mathematics and its interactions with the social sphere, especially through financial and insurance mathematics. The competences for applied learning outcomes are provided by social partners, which is very positive and important to create a good match between mathematical learning outcomes, professional skills and labour market needs.

68% of the teachers are in the <50 age group with a single staff member over 60 and 40% in the <40 age group. This situation induces a dynamic between experiences teachers and younger staff members who bring rejuvenation to the programme. The age repartition is also favourable to the viability of the programme with no a priori threat of staff shortage. Although the recruitment procedure of teachers is not detailed in the SER, it should be noted for future reference that the external expert team recommends that open calls be set up and the positions advertised in order to potentially attract the best researchers from Lithuania and other Baltic and neighbouring countries.

The international recognition of the research carried out by the staff members is acknowledged by scientific publications in international journals (35 article papers published in the 2012-16 period belong in the Clarivate Analytics Web of Science database), the editorial work of several professors who are members of editorial boards of international journals, and the regular participation in international conferences. International conferences are also organized locally, such as the second International Conference on Number Theory. Teachers are involved in international projects and several teachers leave for short term internships on exchange programmes. A few incoming teachers are also mentioned in the SER and they quite efficiently contribute to the teaching programme. Moreover, all teachers in SU are provided with equal conditions for professional development and the funding seems sufficient to allow the required

international mobility. Teachers have a right to take a sabbatical every 5 years, which is favourable to the development of research and the international mobility.

The current teaching load of teachers stated in the SER is 792 hours /year (contact work with students). During the interviews, it was clarified that the number of contact hours in class rooms was about 500 hours/year. The SER does not make any comment on this huge working load, by comparison with international standards. It should be pointed out that, in the view of the external expert team, such a teaching load doesn't offer decent conditions for professional development as a researcher on the international scale, which is bound to lead to negative effects on the programme.

Moreover, the opportunity to take a sabbatical has never been taken by any teacher involved in the program. It was clarified during the interviews that low salaries of academics in Lithuania often induce a necessity for a second job and therefore hinders the capacity of a teacher to take a sabbatical. It was also elucidated that the number of contact hours is determined every year by the Senate of the University, as well as the ratio between teaching and research activities. The external evaluation program would like to raise the attention of the University authorities on the importance of ensuring good conditions for research since university studies are based on their relationship with fundamental and applied research. Measures should be taken to reduce the number of contact hours in order to guarantee research conditions of staff members for the long-term viability of the study programme.

Finally, the teachers develop their pedagogical competencies through courses and methodological seminars. A "Teacher of the Year" award has been created to raise teachers' motivation regarding teaching. The external expert team stresses that initial teacher training of PhD students and young doctors should be systematically encouraged. A proper plan of professional development for university teachers should include seminars on 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. Issues related to the teaching and learning of given mathematical topics should be discussed by the teaching staff during seminars, those seminars shouldn't restrict to general pedagogical concerns.

2.4. Facilities and learning resources

Theoretical lectures are delivered in 15 classrooms for general use (with 14 - 70 seats) and 5 computer classrooms (with 2x14, 2x13, 1x12 seats). Classrooms are equipped with multimedia systems, in computerized classrooms are interactive whiteboards and printers. In *E-Studies Centre* is created to use video conferencing classroom and hall, LieDM distance learning/teaching classroom. What allows up to 35 persons or auditoriums participating in video conferences can be connected into one or several interactive synchronous events that are held in parallel. Wireless internet access (EduROAM) is available for teachers and students in all faculty premises.

The students conduct Practice in enterprises. The Faculty has a possibility to use the database of University practice placements. The practical placement is chosen in two ways: either the students select practical placements individually or they are allocated by the practice supervisor of the Faculty. The Faculty has adequate arrangements for students' practice. During the interviews with students it was confirmed that practical placement is organised efficiently.

The premises for studies are adequate in their size and quality. Quantity, quality and media/IT facilities of the teaching rooms are in line for the programme implementation and the student's needs in their studies. The premises meet labour safety requirements and hygiene norms, are adapted for the disabled students (a lift is equipped, drives for wheelchairs).

To implement *Programme* aims and achieve learning outcomes, the students use one of the most modern libraries in Lithuania - SU library, which is 400 meters from the *Faculty*. In the *Library* there are 273 seats for library users, 114 of them are computerized. In the *Library*, 7 rooms for group work are equipped: 4 rooms can seat 6 persons, 2 rooms – 10 persons, 1 room –

12 persons. There are 5 rooms for individual work with computerized work stations, 3 rooms for seminars (with 20, 30 and 40 seats), which have multimedia projectors, computers, whiteboards). In the *Library* 2 computerized classes are equipped to develop students' ICT skills. There are two modern conference halls: a 180-seat hall with stationary multimedia and the system of simultaneous translation and a video conference hall with 120 seats, which are used for the conferences, seminars for school students, teachers, etc.). There is Wireless Internet access EduROAM in the *Library*. The *Library* houses Publishing Department with modern digital equipment, the service of document scanning, copying, binding or lamination is provided.

The key books, textbooks and other publications that are essential for studying the programme are accessible to students via SU Library. The students and teachers have access to 23 scientific databases. Specialists of mathematics and students have access and can find the most of information in multidisciplinary databases: *AcademicSearchComplete*, *eBookCollection*, *MasterFILEPremier*, *ScienceDirect*, *Springer LINK*, *Taylor&Francis*, etc. Also, the *Library* at certain intervals subscribes free access to databases necessary for mathematicians (*Zentralblatt MATH*, *MathematicalReviews/MathSciNet*, etc. However, during the site visit was not provided information how intensively is used available access to databases. Such monitoring is important in order to see the most used and relevant databases, especially when focus is shifted from physical books to databases.

The teaching materials and technical equipment, such as textbooks, periodical publications, and databases are adequate and up to date for the implementation of the programme and accessible to the students.

2.5. Study process and students' performance assessment

The admission requirements in the Financial Mathematics programme are clearly elaborated and they follow all requirements applied for the 1st cycle studies. The candidates can apply for this programme if they have acquired High School diploma certificate. In 2016, the competitive point was composed of matura examination grades or annual grades of mathematics (impact coefficient 0,4), physics or information technologies (0,2), the Lithuanian language and literature (0,2) and another subject, different from other subjects (0,2).

The general trend in Lithuanian HEIs is that the number of students is decreasing. Therefore, the programme faces with significant variations in the number of the admitted students (2012-11, 2013-5, 2015-6, 2016-5). Although the number of admitted students has not changed significantly in the recent years but the number of applicants has decreased dramatically from 71 in 2012 to 17 in 2016. The decrease highlights that the programme management should consider additional means how to attract students from other regions or countries.

The entrance score has also the negative trend as the average score has decreased from 7,37 in 2015 to 6,27 in 2016 for state funded places and from 4,327 in 2015 to 2,610 in 2016 for non state funded places. The decrease in the score shows that there might less motivated and weaker students applying for the programme. In the long term it will decrease the quality of studies and might increase the drop out rate. For now only 4 students were crossed out from the list and the majority left the programme due to inability to fulfil academic requirements.

The general rules for the assessment of students' achievements are clearly elaborated in the faculty and SU Study Regulations. The on-site visit showed that students are well-informed about all requirements they have to follow during the study process, study programme, its aims, developed abilities, evaluation system, elective alternatives, requirements for Bachelor Thesis preparation, mobility possibilities, career possibilities, 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. Additionally, there is a feedback giving culture among the students and the professors – students evaluate study modules every semester, receive constant feedback on their examination results and are able to personally provide the feedback to the professors as well as fill in the questionnaires.

Bachelor thesis is defended in public, with participation of Bachelor Thesis and its Defence Assessment Committee, research supervisor, reviewers and the students defending the works. The committee consists not only of research professionals, professors but also a social partner. The process of Bachelor thesis preparation is clearly defined in the internal documents and during the visit student's were satisfied with the procedure of internship and Bachelor thesis.

The students of this programme have the possibility to get variety of support such as career development, job openings, library, accommodation, cultural activities etc. Additionally, students are able to receive different types of financial support such as incentive, one-time, targeted and social. The number of students in this programme was awarded with the scholarship for different reasons during the recent years.

Additionally, the students are encouraged to participate in additional activities such as helping to organize regional, national and international Olympiads of Mathematics. Nevertheless, there is no significant example of bachelor students participating in research activities such as joint works with the professors or participating in the research conferences. This are could be improved in the future.

The faculty has a number of agreements with the universities for students and professors to temporarily study abroad. Nevertheless, the number of students using this opportunity (1-2 students per year) is very low due to the high employment rates and financial reasons as well. There was 1 student from abroad coming to this study programme and the study material was prepared for student in English. Additionally, during expert's visit, the university held an International week highlighting the importance of internationalization. Nevertheless, as the importance of internationalization is increasing in the market, students during the meeting stressed out that more subjects could be lectured completely in English in order to be competitive in the labour market.

The faculty is also taking measures to increase academic honesty. The requirements for academic honesty are defined in a range of the University documents: Šiauliai University Students' Ethics Code⁸⁵, sanctions for academic dishonesty are foreseen in ŠU Study Regulations. Additional means are organized by students representatives in order to discourage students from cheating. All Bachelor Theses are placed in eLABa for the verification of originality.

According to SER, the employability rate is very high and reached around 80% 1 year after graduation. The examples of employers for this programme graduates consist of AB "Swedbank", UAB "Putokšnis", UAB "Laudita". Taking into account the employees of graduates, the majority of them are working according to the field of Mathematics as consultants, auditors, specialists etc. During the expert's visit, the stakeholders highlighted the need of such specialists and appreciated student's ability to solve complex tasks quickly and in a qualitative manner.

2.6. Programme management

The implementation process of the study programme is maintained and conducted at a proper level. All hierarchic structural units (University, Faculty, Department), as well as associated individuals (students, teachers, office employees), are involved in this process. Responsibilities for decision-making and monitoring of the programme are clear and successfully allocated.

The collected information (programme and its amendments, anonymous surveys' results, news coming from various discussions on the matter, round table issues, etc.) is regularly provided by the Department, Dean's office, the study programme committee (SPC) and the academic staff, and appears either in AIS (Academic information system) or on the University website, regional TV, Facebook, etc). The collection of data on the employer's opinion is standardized and formalized at the Institute level (publicly available on the University website).

The internal study quality assurance measures are efficient. Once a year, before a new academic year, the SPC conducts an internal assessment of the programme (with stakeholders involved), submits conclusions. The University Working Group for internal expertise of study programmes' descriptions and counselling contributes a lot to the assurance of study quality. The students are also involved in the improvement process of the programme. Joint meetings with graduates and social partners, Quality Days are organized regularly. This information was also confirmed during the meetings with various target groups. The Cross-Sectorial Partnership Centre was opened at the University. The only shortcoming which can be indicated in the programme's management model is linked with not fully spread out internationalization of the programme and manifestation of glaring publicity (press, TV, etc.) about the prospects and long-term future of the University. The latter circumstance exerts negative influence on the enlisting process of applicants to the programme.

Exceptionally clear description and successful allocation of responsibilities for decision-making and monitoring of the programme as well as the prepossessing and qualified teaching staff and fruitful cooperation with social partners are very recognizable. Worth emphasizing, the programme administrators see further development of the study programme (Self-evaluation-report; page 36) in strengthening of its internationality dimension, by improving collaboration with foreign higher educational institutions, inviting foreign teachers to deliver lectures, attracting students from abroad, etc. No doubt, all this is a praiseworthy aim of the programme managers.

III. RECOMMENDATIONS

1. All competences and learning outcomes are formally well described. It would be necessary to reconsider them and write in more appropriate form, especially emphasizing the acquired knowledge and its applications which characterize this study programme among others.
2. The programme curriculum design is very intensive. It is recommended for the faculty to reconsider the study period of seven semesters in order to be confident that all ambitious programme learning outcomes are achieved by the students at good level.
3. The review team recommends a reorganization of the courses “Methods of Optimization” and “Operations Research” so to avoid possible overlap in contents. Moreover computer algebra and other software should be effectively used in some theoretical courses if possible.
4. The faculty should utilize its strength to attract students. A possible improvement could be design of a course (could be an existing course) with theory in centre and applications in periphery. To mention one but not limited to it, analytical number theory is very strong among the faculty. A course on this topic can be extended to dynamical systems whose link to financial mathematics is apparent. It also provides a student for further study in more theoretical study.
5. The programme’s implementers should intensify their efforts and actions in ameliorating research environment for the teaching staff by lowering their pedagogical workload hours to approach the international standard of 200 contact hours/year. Equally, improving teachers English communication skills would allow to increase number of students and enhance the long-term viability of the 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. It is recommended to increase the number of subjects lectured completely in English in order to strengthen international dimension, i.e. to invite foreign teachers to deliver lectures, to attract students from abroad. Again the bottom line is to increase number of students.
8. The spectrum of study methods needs to be widened by introducing more presentations, group work and project-based teaching (learning) schemes in order to reach the main aims of the programme.

IV. SUMMARY

The aim of bachelor study programme “Financial Mathematics” is *to educate students in financial and insurance mathematics to be capable of combining the acquired and integrate*

new fundamental knowledge of mathematics, interdisciplinary financial, insurance and information technologies for the formation and development of competences necessary for interdisciplinary studies, scientific research or professional (of actuary, finances, and/or operations research analyst, insurance specialist activity). This programme was registered in 2012 in the scope of 240 ECTS and had not been evaluated by external experts. In the scope of 210 ECTS has been implemented only two academic years. Programme implementation shows the good cooperation between Šiauliai University and stakeholders. Teaching methods, such as Moodle platform, project-based method, etc. are developed in compliance with the challenges of new academic development, IT technologies and labour market needs. Students competencies acquired in this programme, such as theoretical knowledge, hands-on and soft skills correspond to the labour market needs. Internationalization of this study programme is recognized through mobility of teaching staff, mobility of students, visiting professors to teach some courses, organization of internationalization week, etc.

The objectives and learning outcomes are clear, well defined, publicly announced, though very ambitious for 210 ECTS credits. Hence it would be important to analyze subjects' competences and recognize firstly weaknesses and upon that propose an improvement of learning outcomes. The review team would like also to emphasize that the teaching and administrative staff need to recognize the main weaknesses of the study programme such as the low number of enrolled students; lack of specialists in areas of algebra, geometry, topology and consequently lack of corresponding contents in curriculum, important for applications in big data analysis, complexity systems, developing of problem solving skills, etc. The capability to recognize weaknesses is essential for improvements. Quality of foundations of mathematics due to a proper background of corresponding master degree programme is not yet acquired. Teaching staff should discuss how to make some subjects to be more attractive (e.g. by choosing proper examples from real world to illustrate theory, etc.)

V. GENERAL ASSESSMENT

The study programme Financial Mathematics (state code – 612G17002) at Šiauliai 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	3
2.	Curriculum design	2
3.	Teaching staff	3
4.	Facilities and learning resources	3
5.	Study process and students' performance assessment	3
6.	Programme management	3
	Total:	17

*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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V. APIBENDRINAMASIS ĮVERTINIMAS

Šiaulių universiteto studijų programa *Finansų matematika* (valstybinis kodas – 612G17002) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	3
2.	Programos sandara	2
3.	Personalas	3
4.	Materialieji ištekliai	3
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	3
	Iš viso:	17

* 1 - Nepatenkinamai (yra esminių trūkumų, kuriuos būtina pašalinti)

2 - Patenkinamai (tenkina minimalius reikalavimus, reikia tobulinti)

3 - Gerai (sistemiškai plėtojama sritis, turi savitų bruožų)

4 - Labai gerai (sritis yra išskirtinė)

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IV. SANTRAUKA

Finansų matematikos bakalauro studijų programos tikslas – *ugdyti finansų ir draudimo matematikos specialistus, gebančius sujungti įgytas bei integruoti naujas fundamentines matematikos, tarpdisciplinines finansų, draudimo ir informacinių technologijų žinias, formuoti ir plėtoti kompetencijas, reikalingas tarpdalykinėse studijose, moksliniuose tyrimuose ar profesinėje (aktuario, finansų ir (ar) operacijų tyrimo analitiko, draudimo specialisto) veikloje*. Programa buvo užregistruota 2012 m., jai suteikta 240 ECTS kreditų. Programa nebuvo vertinta išorinių ekspertų. 210 ECTS kreditų verta programa trunka dvejus metus. Programa įgyvendinama bendromis Šiaulių universiteto ir jo darbuotojų bei studentų pastangomis. Atsižvelgiant į naujus akademinis pokyčius, informacinių technologijų ir darbo rinkos poreikius, parengti tokie mokymo metodai kaip naudojimas „Moodle“, projektinis mokymų metodas ir kt. Šioje programoje studentai įgyja darbo rinkos poreikius atitinkančių teorinių žinių, praktinių ir socialinių įgūdžių. Programos tarptautiškumas didinamas per dėstytojų ir studentų judumą, kviečiant profesorus dėstyti kursus, organizuojant tarptautiškumo savaitę ir kt.

Tikslai ir mokymosi rezultatai yra aiškūs, gerai apibrėžti, viešai paskelbti, nors ir labai ambicingi 210 ECTS kreditų vertai programai. Todėl svarbu pirmiausia išanalizuoti ugdymus gebėjimus, nustatyti trūkumus ir pateikti atnaujintus mokymosi rezultatus. Ekspertų grupė taip pat norėtų pabrėžti, kad programos dėstytojai ir administratoriai turėtų pripažinti pagrindinius studijų programos trūkumus, t. y. mažą užsiregistravusių studentų skaičių, algebros, geometrijos ir topologijos specialistų bei šių dalykų, kurie yra reikalingi dideliems duomenims analizuoti, sudėtingumo sistemoms, problemų sprendimo įgūdžių ugdymui ir kt., trūkumą mokymo

programoje. Gebėjimas pripažinti trūkumus yra būtinas norint juos ištaisyti. Matematikos pagrindų dėstymas nėra pakankamai kokybiškas. Dėstytojai turėtų aptarti, kaip padidinti kai kurių studijų dalykų patrauklumą (pvz., pateikti atitinkamus teoriją pagrindžiančius realių situacijų pavyzdžius ir pan.).

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III. REKOMENDACIJOS

1. Visi gebėjimai ir studijų rezultatai yra gerai apibrėžti. Reikėtų juos peržiūrėti ir apibrėžti tinkamesne forma, ypač pabrėžiant įgytas žinias ir jų taikymą, ypatybes, išskiriančias šią studijų programą iš kitų.
2. Programa yra labai intensyvi. Fakultetui rekomenduojama iš naujo apgalvoti septynių semestrų studijų laikotarpį siekiant užtikrinti, kad visi ambicingi studijų programos rezultatai būtų pakankamai gerai pasiekti.
3. Ekspertų grupė rekomenduoja pertvarkyti optimizavimo metodų ir operacijų tyrimų kursų ir užtikrinti, kad jų turinys nesidubliuotų. Taip pat esant galimybei kai kuriuose teoriniuose kursuose galėtų būti naudojama kompiuterinė algebra ir kita programinė įranga.
4. Fakultetas turėtų pabrėžti programos stipriąsias puses studentams pritraukti. Vienas iš būdų pagerinti programą galėtų būti naujas (arba išplėstas jau esamas) teorinis kursas, studentams sudarantis galimybes praktiškai pritaikyti įgytas žinias. Kaip pavyzdį pateikiame fakultete gerai įtvirtintą analizinės skaičių teorijos kursą. Jį galima būtų išplėsti įtraukiant dinamines sistemas, akivaizdžiai susijusias su finansų matematika. Tokiu būdu studentams taip pat suteikiama tolesnių teorinių studijų galimybė.
5. Programos vykdytojai turėtų aktyviau gerinti mokslinių tyrimų aplinką dėstytojams, mažindami dėstytojų pedagoginio darbo valandas iki tarptautiniu mastu pripažįstamų 200 kontaktinių valandų per metus. Mokytojų bendravimo anglų kalba įgūdžių gerinimas taip pat leistų padidinti studentų skaičių ir pagerintų studijų programos ilgalaikes perspektyvas.
6. Tarptautinis dėstytojų judumas turi būti skatinamas per mainų programas ir kūrybines atostogas. Turi būti sistemingai skatinamas doktorantūroje studijuojančių ir jas neseniai baigusių studentų rengimas mokytojauti. Mokymai neturėtų apsiriboti bendrosiomis pedagoginėmis temomis ir IRT įgūdžiais, bet taip pat turėtų apimti refleksyvųjų mąstymą apie mokymą ir matematikos temų mokymąsi.
7. Siekiant padidinti tarptautiškumą, t. y. pritraukti daugiau užsienio dėstytojų ir studentų, rekomenduojama siūlyti daugiau dalykų anglų kalba. Tikslas yra padidinti studentų skaičių.
8. Kad būtų pasiekti pagrindiniai programos tikslai, studijų metodai turi būti išplėsti darant daugiau pristatymų, aktyviau dirbant grupėse ir sukuriant daugiau projektinio mokymosi galimybių.

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