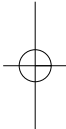
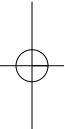
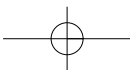
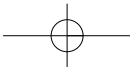
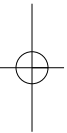
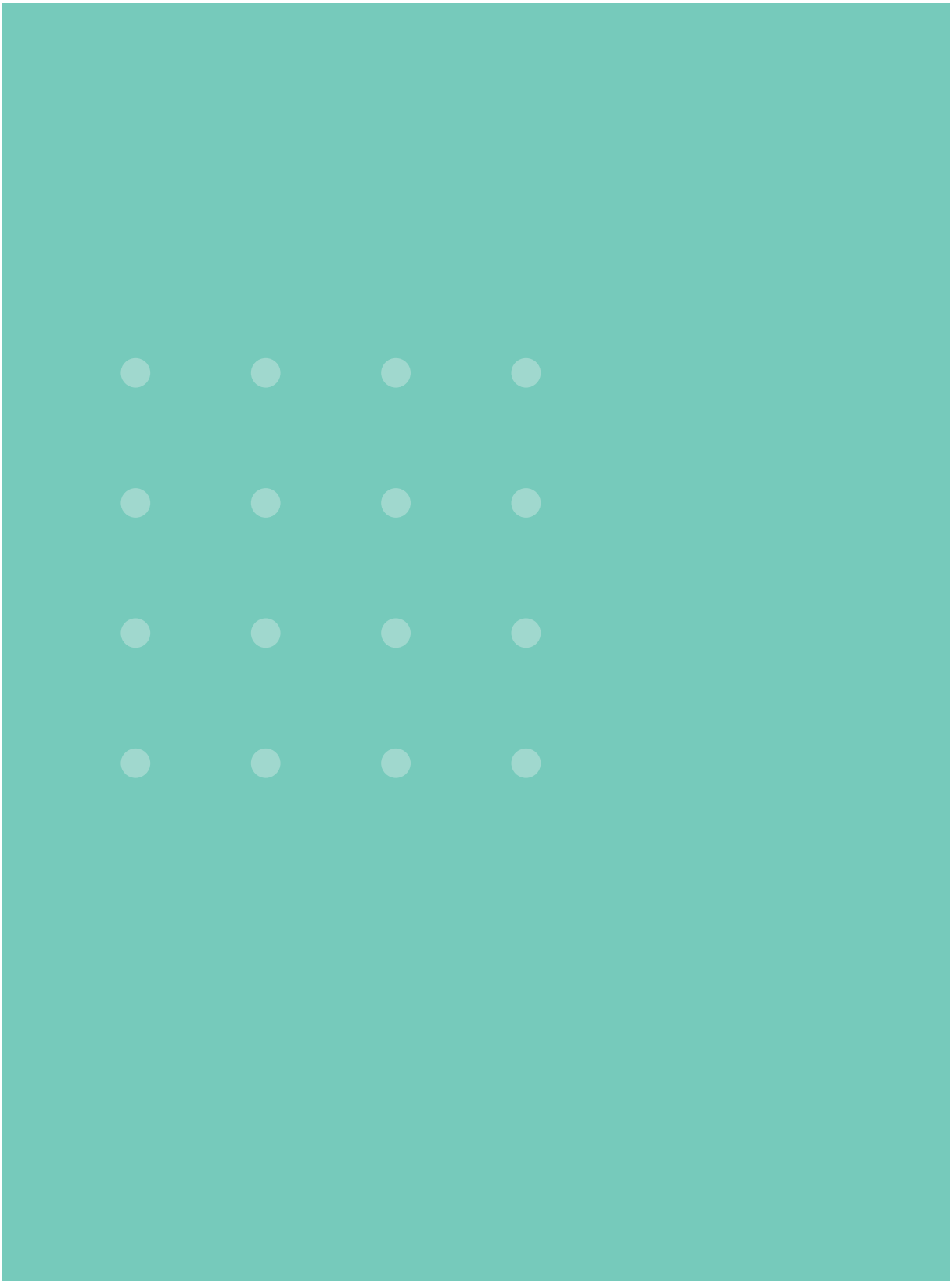
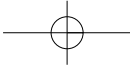


financial mathematics

academic
study
program





FINANCIAL MATHEMATICS

■ Study program cycle and type:

First cycle academic study program.

■ Anticipated academic title:

Bachelor in Financial Mathematics (academic).

In Slovenian: *diplomirani finančni matematik (UN)*, *diplomirana finančna matematičarka (UN)*, abbreviated to *dipl. fin. mat. (UN)*.

■ Duration:

3 full years (6 terms) based on 180 ECTS credits.

■ Basic goals:

The principal goal of the academic study program in Financial Mathematics is to create experts capable of solving hard mathematical problems arising in the banking and insurance sector, in trading activities of stock exchanges and brokerage firms, and in management of pension and health funds. Graduates of this study program also acquire enough theoretical knowledge to be able to proceed with the Financial Mathematics program in the second cycle.

■ Generic competencies developed by the student:

- ability of abstract thinking and problem analysis,
- ability of sorting out effective solutions and of their critical evaluation,
- ability of application of knowledge at solving practical problems,
- ability of using and following the expert literature,
- ability to set forth both written and oral presentations of specialized topics,
- ability to work both individually and as part of an (international) team,
- ability of lifelong self-education.

■ Subject specific competences developed by the student:

- basic knowledge of mathematics, basic knowledge of economics and finance, basic knowledge of informatics,
- ability to solve non-deterministic problems with the help of probability theory and statistics,
- ability to solve deterministic problems with the help of optimization methods and operations research,
- ability of computation of approximate solutions with the help of numerical methods,
- ability to use computers to solve problems and present results.

■ Employment possibilities:

Graduates of the academic study program in Financial Mathematics can find employment in:

- banks and insurance companies,
- stock exchanges and brokerage firms,
- pension and health benefits companies,
- both the public sector and agencies as well as in the private sector, for example the logistics sector (optimization).

The program is in tune with the principles of the Bologna Declaration.

academic
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CURRICULUM

The spreadsheet data are given for both the winter and the summer term.
Each term comprises 15 weeks of classes.

Abbreviations: L = lectures per week (in hours),
P = problem sessions per week (in hours),
Lab = lab classes per week (in hours),
ECTS = ECTS credits worth,
TSW = estimated total student workload (in hours).

1st YEAR

Course	Winter term					Summer term					Total	
	L	P	Lab	ECTS	TSW	L	P	Lab	ECTS	TSW	ECTS	TSW
Analysis 1	3	3	0	7	210	0	0	0	0	0	7	210
Analysis 2	0	0	0	0	0	3	3	0	7	210	7	210
Algebra 1	4	4	0	9	270	2	2	0	5	150	14	420
Discrete mathematics 1	2	2	0	5	150	0	0	0	0	0	5	150
Microeconomics	0	0	0	0	0	4	2	0	6	180	6	180
Optimization methods	0	0	0	0	0	3	3	0	6	180	6	180
Proseminar	2	2	0	4	120	0	0	0	0	0	4	120
Computer lab	1	0	3	6	180	0	0	0	0	0	6	180
Introduction to programming	0	0	0	0	0	2	1	1	5	150	5	150
Weekly total	12	11	3			14	11	1				
Term total	180	165	45	31	930	210	165	15	29	870	60	1800

2nd YEAR

Course	Winter term					Summer term					Total	
	L	P	Lab	ECTS	TSW	L	P	Lab	ECTS	TSW	ECTS	TSW
Analysis 3	4	4	0	9	270	0	0	0	0	0	9	270
Probability theory 1	2	2	0	5	150	2	2	0	5	150	10	300
Money and finance	0	0	0	0	0	3	3	0	6	180	6	180
Financial mathematics 1	0	0	0	0	0	2	2	0	5	150	5	150
Macroeconomics	3	3	0	6	180	0	0	0	0	0	6	180
Financial markets and institutions	0	0	0	0	0	4	2	0	6	180	6	180
Programming 1	2	0	2	5	150	0	0	0	0	0	5	150
Numerical methods 1	2	2	0	5	150	0	0	0	0	0	5	150
Numerical methods 2	0	0	0	0	0	2	2	0	5	150	5	150
Seminar 1	0	2	0	3	90	0	0	0	0	0	3	90
Weekly total	13	13	2			13	11	0				
Term total	195	195	30	33	990	195	165	0	27	810	60	1800

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3rd YEAR

Course	Winter term					Summer term					Total	
	L	P	Lab	ECTS	TSW	L	P	Lab	ECTS	TSW	ECTS	TSW
Financial lab	0	0	0	0	0	1	3	0	5	150	5	150
Statistics 1	2	2	0	5	150	2	2	0	5	150	10	300
Random processes 1	2	2	0	5	150	0	0	0	0	0	5	150
Operations research	0	0	0	0	0	3	3	0	6	180	6	180
Game theory	3	3	0	6	180	0	0	0	0	0	6	180
Seminar 2	0	0	2	3	90	0	0	1	1	30	4	120
Elective courses	5	5	0	11	330	6	5	0	13	390	24	720
Weekly total	12	12	2			12	13	1				
Term total	180	180	30	30	900	180	195	15	30	900	60	1800

In addition to the obligatory courses, each student opts for elective courses of total worth 24 ECTS credits. Of those, at least 5 ECTS credits must be earned by taking courses offered by the Department of Mathematics at the FMF, and at least 5 ECTS credits by taking courses offered by the Department of Money and Finance at the Faculty of Economics (EF).

Of the courses offered by the Department of Money and Finance, the following clusters are recommended:

Macroeconomics cluster:

Course	ECTS
– Financial economics	4
– Public finance	6
– International finance	6
– Monetary economics	6

Entrepreneurial finance cluster:

Course	ECTS
– Corporate finance 1	6
– Theory of corporate finance	4
– Taxes and corporate tax burden	6
– Financial statement analysis	4

Financial institutions and financial markets cluster:

Course	ECTS
- Corporate finance 1	6
- Financial institutions	6
- Financial institutions management 1	4
- Theory of financial intermediation	4

The following is a list of possible mathematically oriented elective clusters:

Applied mathematics cluster:

Course	ECTS
- Mathematical modelling	5
- Coding theory and cryptography	5
- Discrete mathematics 2	5

Computer science cluster:

Course	ECTS
- Data structures and algorithms 1	5
- Data structures and algorithms 2	5
- Database basics	5

Fundamental mathematics cluster:

Course	ECTS
- Point-set topology	5
- Algebra 2	6
- Algebraic curves	5
- Introduction to geometric topology	5
- Algebra 3	6
- Affine and projective geometry	5
- Introduction to differential geometry	5

Students studying at a foreign institution as part of the Socrates-Erasmus exchange program can transfer up to 30 ECTS credits awarded at that institution in the case of a single term exchange or 60 ECTS credits in the case of a full year exchange.

COURSE DESCRIPTIONS

1st year

- > **Analysis 1**
 - Number of ECTS credits: 7
 - Course goals and competences: Familiarity with the rudiments of mathematical analysis: functions, limits, continuity, derivation and integration of functions of one real variable.
 - Remark: Analysis 1 is one of the core courses in mathematical studies.
 - Responsible faculty: Prof. Edvard Kramar

- > **Analysis 2**
 - Number of ECTS credits: 7
 - Course goals and competences: Familiarity with some new basic notions and techniques of mathematical analysis and differential geometry and their applications.
The acquired knowledge represents a basis for other mathematical courses.
 - Responsible faculty: Prof. Edvard Kramar.

- > **Discrete mathematics 1**
 - Number of ECTS credits: 5
 - Course goals and competences: Familiarity with basic discrete structures and combinatorics, as well as elementary graph theory.
 - Responsible faculty: Prof. Martin Juvan and Prof. Marko Petkovšek.

- > **Algebra 1**
 - Number of ECTS credits: 14
 - Course goals and competences: Familiarity with the basic concepts of linear algebra; vectors, vector spaces, linear maps and matrices. Development of the mathematically correct way of thinking about problems. Familiarity with the strict mathematical language. Acquisition of practical working knowledge of the subject by means of problem sessions.
 - Remark: Algebra 1 is also one of the core courses of mathematical studies.
 - Responsible faculty: Prof. Boris Lavrič.

- > **Microeconomics**
 - Number of ECTS credits: 6
 - Course goals and competences: Familiarity with the basic problems in economics and the ways of solving them. Acquisition of detailed knowledge of the theory of production and cost, of functioning of the market mechanism, and of the theory of distribution. Acquisition of the basic analytical and categorical apparatus needed for other economic courses. Familiarity with the institutional framework, with organizational and proprietary business types, and the business environment co-formed by government regulations.
 - Responsible faculty: Prof. Aljoša Feldin.

- > **Optimization methods**
 - Number of ECTS credits: 6
 - Course goals and competences: A unified presentation of the basic theory of continuous and combinatorial optimization.
 - Responsible faculty: Prof. Vladimir Batagelj.

- > **Proseminar**
 - Number of ECTS credits: 4
 - Course goals and competences: Review of high school mathematics needed for other courses in the first year of the study program.
 - Responsible faculty: Prof. Petar Pavešić.

- > **Computer lab**
 - Number of ECTS credits: 6
 - Course goals and competences: Acquisition by the student of the basic knowledge about the software they will use in the course of their studies. Capacity to use the internet, email and electronic lists, as well as numerical software used in analysis and algebra. Understanding and the capacity to use operational systems. Capacity to use word processors with the emphasis on creating and editing mathematical texts.
 - Responsible faculty: Prof. Andrej Bauer and Dr. Matjaž Zaveršnik.

- > **Introduction to programming**
 - Number of ECTS credits: 5
 - Course goals and competences: Familiarity with basic programming methods, and the basics of programming languages. Understanding the concept of an algorithm. Familiarity with command line and functional programming.
 - Responsible faculty: Prof. Andrej Bauer.

2nd year

> Analysis 3

- Number of ECTS credits: 9
- Course goals and competences: The acquisition of knowledge of some more involved methods in mathematical analysis needed for financial mathematics courses.
- Responsible faculty: Prof. Barbara Drinovec Drnovšek and Prof. Edvard Kramar.

> Probability theory 1

- Number of ECTS credits: 10
- Course goals and competences: Students learn the basics of probability theory. These include the notions of a sample space, events and their probability, and, with special emphasis, the notion of a random variable and its distribution. The notions of mathematical expectation, conditional expectation and conditional distribution follow next, and the course is rounded up with the concept of convergence of random variables and the central limit theorem.
- Responsible faculty: Prof. Matjaž Omladič and Prof. Mihael Perman.

> Money and finance

- Number of ECTS credits: 6
- Course goals and competences: The goal of the course is familiarity with basic notions related to money and finance in the national economy. In the first part of the course, students learn about the introduction of money, the issuing of money, the banking system, and the structure of financial markets and financial institutions. In the second part, students learn about monetary politics and the European and international monetary systems.
- Responsible faculty: Prof. Igor Masten.

> Financial mathematics 1

- Number of ECTS credits: 5
- Course goals and competences: Financial mathematics is based on certain common principles. The goal of this course is to introduce those principles on discrete models which are the most intuitive. The first part comprises the mathematics of life insurance and the principle of equivalence. The question of investments leads to that of market models, optimal investment choice, basic theorem about option pricing and risk measures. An important element of financial mathematics is the development of stochastic interest rate models.
- Responsible faculty: Prof. Andrej Bauer, Prof. Martin Juvan, Prof. Matjaž Omladič, Prof. Mihael Perman, Prof. Marko Petkovšek and Prof. Primož Potočnik.

> **Macroeconomics**

- Number of ECTS credits: 6
- Course goals and competences: The acquisition of the basic knowledge of macroeconomic analysis and policy in the institutional framework of the EU. Familiarity with the basic economic logic of the mixed economy and with the approaches to solving macroeconomic problems. The acquisition of the level of theoretical thinking, and the capacity to apply basic macroeconomics knowledge in the analysis of equilibrium and changes in the national economy. The development by the student of the ability to use positive knowledge in the analysis of measures and opinions of creators of the economic policy.
- Responsible faculty: Prof. Sašo Polanec.

> **Financial markets and financial institutions**

- Number of ECTS credits: 6
- Course goals and competences: The goal of the course is to familiarize students with the modern financial systems within developed economies. Students learn the most important components: the identification of participants, the most frequently traded types of financial instruments, the types of financial markets and their properties, the organization of financial trading and the regulations in the financial sector. The financial markets' determination of the cost of money and the cost of capital which influence the value of financial investments will also be studied. The course builds on the knowledge of finance acquired previously in the course of studies, and is focused primarily on the role of institutional investors within the financial system.
- Responsible faculty: Prof. Marko Košak.

> **Programming 1**

- Number of ECTS credits: 5
- Course goals and competences: Familiarity with a computing language and interactive environment designed primarily for statistical data processing and presentation of results. An example is the programming language and software environment R.
- Responsible faculty: Prof. Martin Juvan.

> **Numerical methods 1**

- Number of ECTS credits: 5
- Course goals and competences: Familiarity with the basics of numerical computations. Enhancement of the knowledge of methods for solving non-linear equations and systems of linear equations by complementing the previously studied analytical methods with some of the well-known numerical methods. Solidification of knowledge and familiarity with numerical computation software packages by means of solving practical problems at problem sessions and homework.
- Responsible faculty: Prof. Bor Plestenjak.

> Numerical methods 2

- Number of ECTS credits: 5
- Course goals and competences: Familiarity with the basic methods for solving eigenvalue problems, and with the basic methods in numerical approximation and interpolation, numerical integration and finding numerical solutions of ordinary differential equations. Solidification of knowledge by means of solving practical problems at problem sessions and homework.
- Responsible faculty: Prof. Bor Plestenjak.

> Seminar 1

- Number of ECTS credits: 3
- Course goals and competences: Students learn how to prepare short mathematical presentations. By using their own experience and by observation of others, students learn both how to design a presentation and prepare the corresponding material (e.g. transparencies) as well as how to execute it. They acquire the skills needed for a successful presentation and a well written seminar paper. The coordinator of the seminar prepares a list of sufficiently many short self-contained topics which are assigned to students, and provides sufficient literature. Students may find additional literature at will.
- Responsible faculty: Prof. George Mejak, Prof. Bor Plestenjak and Prof. Tomaž Košir.

3rd year

> Financial lab

- Number of ECTS credits: 5
- Course goals and competences: The concepts of financial mathematics and statistics acquire their true value only through practical experience. The goal of this course is a guided conduct of large-size projects in financial mathematics and statistics with the use of real-life data and the appropriate software packages.
- Responsible faculty: Prof. Mihael Perman and Prof. Primož Potočnik.

> Statistics 1

- Number of ECTS credits: 10
- Course goals and competences: The introduction of a theoretical basis of statistical modelling and an exposition of the ways of statistical thinking. Statistics is an indispensable tool in the insurance and finance sector, since it allows for calibration of the models which are the starting point for valuations and testing in the insurance and finance sector.
- Responsible faculty: Prof. Milan Hladnik and Prof. Mihael Perman.

> Random processes 1

- Number of ECTS credits: 5
- Course goals and competences: Introduction of the basic building blocks of the theory of random processes, such as Markov chains in discrete and continuous time, Brownian motion and Poisson processes.
- Responsible faculty: Prof. Matjaž Omladič and Prof. Mihael Perman.

> Operations research

- Number of ECTS credits: 6
- Course goals and competences: An introduction to the methodology of construction of decision models and of their analysis.
- Responsible faculty: Prof. Vladimir Batagelj.

> Game theory

- Number of ECTS credits: 6
- Course goals and competences: Students learn the basics of game theory and its use in modelling different situations, with the emphasis on economics and finance.
- Responsible faculty: Prof. Martin Juvan.

> Seminar 2

- Number of ECTS credits: 3
- Course goals and competences: In the course of the seminar, each student conducts and presents their senior seminar project. The preparation starts in the winter term of the seminar and is finalized in the summer term. In collaboration with other members of the department, the seminar coordinator conceives a sufficient number of self-contained topics together with references to the basic literature. Students are then urged to find and use additional sources of literature by themselves.
- Responsible faculty: Prof. George Mejak, Prof. Bor Plestenjak, Prof. Tomaž Košir.

Admission requirements and admission limitation measures

Admission to the study program is open to either:

- a) Holders of the *matura* certificate.
- b) Holders of the *vocational matura* certificate obtained in any of the four-year high school programs. In this case, an additional examination in one of the general *matura* subjects different from those of the *vocational matura* is required. Either one of the *vocational matura* subjects or the additional one must be mathematics.
- c) Holders of the final examination certificate obtained in any of the four-year high school programs prior to 1 June 1995.

In case the number of applicants exceeds the maximum availability, the applicants are selected according to their final *matura* (or *vocational matura*) grade, their mathematics *matura* (or *vocational matura*) grade, their grade point average (GPA) in the last two years of high school, and their final mathematics grades in the last two years of high school. These are weighted in the following way.

Applicants under a)

- | | |
|--|------------------|
| - <i>Matura</i> certificate grade | 30 % of points |
| - <i>Matura</i> mathematics exam grade | 30 % of points |
| - GPA in the 3 rd and 4 th years of high school | 20 % of points |
| - Final grade in mathematics in the 3 rd and 4 th years of high school | 20 % of points ; |

Applicants under b)

- | | |
|--|------------------|
| - <i>Vocational matura</i> grade | 20 % of points |
| - <i>Matura</i> or <i>vocational matura</i> mathematics exam grade | 40 % of points |
| - GPA in the 3 rd and 4 th years of high school | 10 % of points |
| - Final grade in mathematics in the 3 rd and 4 th years of high school | 30 % of points ; |

Applicants under c)

- | | |
|--|----------------|
| - Final examination grade | 30 % of points |
| - Mathematics final examination grade or mathematics grade in the 4 th year of high school in case of exemption from the final exam | 30 % of points |
| - GPA in the 3 rd and 4 th years of high school | 20 % of points |
| - Final mathematics grade in the 3 rd and 4 th years of high school | 20 % of points |

Enrollment requirements

Enrollment in the first study year is granted upon admission.

For enrollment in the next study year it is necessary to earn 48 ECTS credits from courses and exams in the current study year.

In addition to the credit quota, the completions of the following exams are obligatory:

- for enrollment in the 2nd year: Analysis 1, Analysis 2, Algebra 1, and Computer lab,
- for enrollment in the 3rd year: all the exams of the 1st year, Probability, and Analysis 3.

Re-enrollment requirements

For re-enrollment in the same study year, a student needs to earn:

- a) at least half of all possible credits of the current study year (30 ECTS credits), and
- b) all credits from the previous study years.

Re-enrollment is only possible once in the course of studies. A change of the study program as result of disability of enrollment in the next study year is automatically counted as re-enrollment.

Finishing requirements

To finish the program, students need to complete all exams.

Validation of competences, knowledge, and skills acquired prior to admission to the study program

Students may apply for validation of their competences acquired previously by means of various forms of education if their competences match those of one or more courses offered within this study program. In a formal written request submitted to the mathematics department at the FMF, the applicant must specify the course(s) whose competences he or she had already mastered, and attach accredited transcripts proving it. When considering the possible validation of competences corresponding to a particular course, the department study committee bases its decision on a comparison of

- the duration of the educational process where the student acquired the competences with the duration of the respective course(s), and
- the scope of the previously acquired competences with the goals of the respective course(s).

If the study committee decides to validate the previously acquired competences, the student is awarded all ECTS credits that correspond to the respective course(s). In the validation process, the study commit-

tee follows *The rules and guidelines for validation of informally acquired knowledge and skills*, accepted by the Senate of The University of Ljubljana on 29 May 2007 (http://www.uni-lj.si/o_univerzi_v_ljubljani/statut_in_pravilniki.aspx).

Grading system:

The methods for testing the competences, knowledge, and skills are described in the courses syllabi. The basic knowledge testing rules are explained in the Exam guidelines of the FMF. Course examinations are either written or oral or both. They can have the form of midterm exams, oral defense of midterm exams, written exams, oral exams, seminar or project work and oral defense of seminar and project work. Grading is based on the grading scale determined in the Statute of The University of Ljubljana. All forms of examinations are graded by grades 1-10, out of which 6-10 are passing grades, and 1-5 are failing grades. The following grading scale is most commonly used for grading the score of a written course examination:

Score (in %)	grade
50 - 59 %	6
60 - 69 %	7
70 - 79 %	8
80 - 89 %	9
90 - 100 %	10

