

MATHEMATICS

Study Programmes





“Science is a way of life.
Science is a perspective.
Science is the process that
takes us from confusion to
understanding...”

Brian
Greene



CONTENTS

FSTM at a glance	5
Why study Mathematics?	6
Our study programmes	8
Bachelor en Mathématiques	10
Master in Mathematics	14
Master in Secondary Education - Mathematics	16
Master of Data Science	18
Doctoral Programme in Mathematics and Applications	20
Our Department of Mathematics	22
Studying at our University	24
Discover Luxembourg	26



The Faculty of Science, Technology and Medicine (FSTM) **at a glance**

1 
faculty

5 
departments

3 
campus sites


2000 
students

from 
100
different
countries

60% 
international
students

more than **500** 
staff members

31 
study programmes

1 
doctoral school

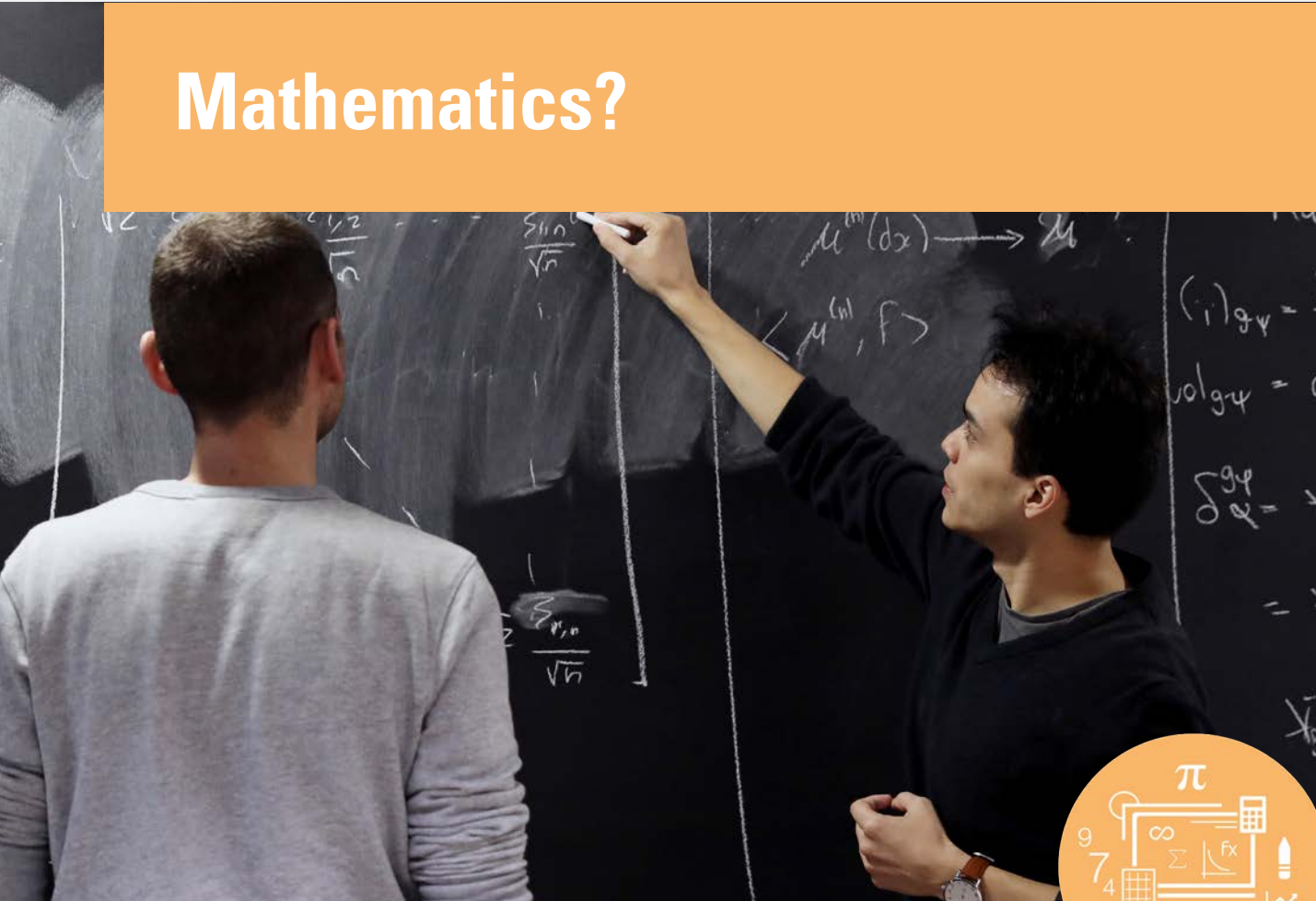
more than **500** 
doctoral candidates

3 official
languages
  



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Mathematics?



Mathematics: a trip to the frontiers of human knowledge

Mathematics is a rigorous and demanding intellectual pursuit, where creativity and the ability to think outside the box play crucial roles. Enjoyed for its clarity, it is both exciting and challenging. One of the first things you learn as a student is how broad and varied it is. As you learn more, you develop a taste for certain branches or types of mathematics. Mathematicians, when describing what they work on, will often speak of beauty and elegance. Studying mathematics is a trip to the frontiers of human knowledge, and becoming a mathematician allows you to be part of an expanding and fascinating discipline.

Learning mathematics is much more than acquiring a body of knowledge. It is also learning how to think deeply, how to reason analytically, how to think quantitatively, and how to work in a problem solving environment. Mathematicians develop a knack for identifying hidden structures in natural, scientific or social environments. As a tool, mathematics is used across science and, increasingly, in a variety of other areas such as in business, finance, engineering, sociology, and even in art. It also teaches one to be precise in thoughts and words and these are invaluable skills that are useful anywhere.

Studying Mathematics in Luxembourg

MANY OPPORTUNITIES

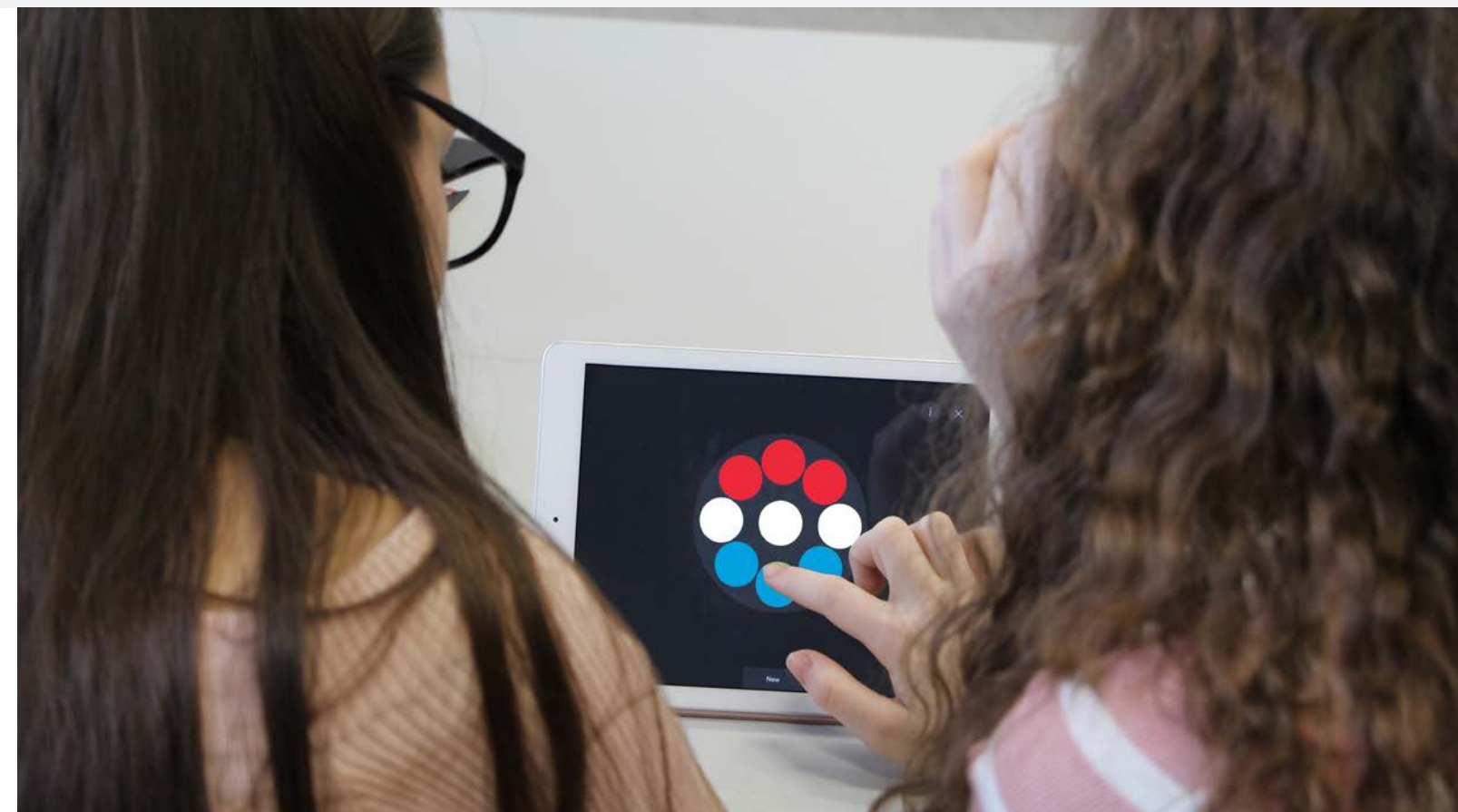
Luxembourg is a small but dynamic country situated in the heart of Europe. Studying in Luxembourg gives you access to its ever expanding job market which is always in need of qualified individuals with analytic and quantitative skill sets. It is both the most cosmopolitan and the fastest growing economy in western Europe, making it a true land of opportunities.

EXCELLENT ENVIRONMENT

Our department consists of world-renowned mathematicians working in diverse fields of mathematics. The low student to teacher ratio ensures that students have a unique opportunity to interact and learn alongside professors who are among the best in the world at what they do. In addition, the activity of the department is deeply rooted in Luxembourg's economical, social and cultural environment. Our flexible study programmes allow students to flourish in accordance with their personal and professional projects. The University of Luxembourg provides an exceptional learning environment. The mathematics department is world class. It is simply a no-brainer.

STRENGTHS

- High level curriculum adapted to an increasingly quantitative economy
- Teachers are leading world experts
- High professor to student ratio
- Motivated students from diverse backgrounds
- Diversified and flexible curriculum and teaching methods
- Access to the dynamic Luxembourgish job market
- Outstanding modern infrastructure



Overview

BACHELOR (3 years)



Bachelor en
Mathématiques

MASTERS (2 years)



Master in Mathematics



Master in Secondary Education
- Mathematics



Master of Data Science

DOCTORAL EDUCATION



Doctoral Programme
in Mathematics and
Applications





Bachelor en Mathématiques

Ce bachelor permet d'acquérir les connaissances de base dans les domaines fondamentaux des mathématiques (algèbre, analyse, géométrie, probabilités) ainsi que des notions provenant de disciplines intimement liées aux mathématiques, telles que la physique, l'informatique ou la didactique des mathématiques.

ATOUTS

- Nombreux modules optionnels chaque semestre
- Forte interaction entre enseignement et recherche
- Possibilité de suivre des cours préparatoires

STRUCTURE DES COURS

Les cours sont regroupés en modules, certains obligatoires, d'autres optionnels. Chaque semestre, l'étudiant/e choisit les cours optionnels qu'il/elle souhaite suivre, ce qui lui permet d'acquérir des connaissances dans un ou plusieurs domaines touchant de près aux mathématiques. En accord avec le processus de Bologne, chaque semestre est crédité de 30 crédits ECTS au moins.

CONDITIONS D'ADMISSION

- Diplôme d'études secondaires au Luxembourg ou diplôme étranger reconnu équivalent par le Ministère de l'Éducation Nationale
- Maîtrise des langues: niveau B2 en français et niveau B1 en anglais

DÉBOUCHÉS

- Master en Mathématiques
- Opportunités professionnelles dans la recherche et l'enseignement, dans le monde industriel, économique ou administratif

PROGRAMME EN UN COUP D'ŒIL

- **Durée:** 3 ans à temps plein / 6 semestres (180 ECTS) dont 1 semestre de mobilité à l'étranger
- **Langues:** français (75%), anglais (25%)
- **Frais d'inscription:**
 - 400€/semestre (1 & 2)
 - 200€/semestre (3 à 6)
- **Périodes d'inscription:**
 - Etudiants UE: avril - août
 - Etudiants non UE: février - avril

INFORMATION ADDITIONNELLE

CONTACT

bmath@uni.lu

CAMPUS

Belval



bmath.uni.lu

PROGRAMME (1/2)

Cours	ECTS
Semestre 1	
Algèbre linéaire	9
Analyse	10
Structures mathématiques	6
Options: choisir au moins 5 ECTS	
Allgemeines Deutsch für Anfänger	3
Didactique des mathématiques	2
Introduction à l'astronomie et à la géodésie	2
Physique expérimentale : mécanique newtonienne, oscillations et ondes	4
Programming fundamentals	5
Total requis	30
Semestre 2	
Algèbre linéaire	7
Analyse	7
Géométries euclidiennes et non euclidiennes	6
Options: choisir au moins 10 ECTS	
Didactique des mathématiques	5
Introduction to geophysics: learning to think like a scientist	2
Logiciels mathématiques	3
Mathématiques expérimentales	4
Mathématique physique	3
Physique expérimentale: électromagnétisme	4
Programming fundamentals	4
Séminaire	2
Water resources: introduction and applied problems	3
Total requis	30

Semestre 3	
Algèbre	7
Analyse	7
Probabilités et statistiques	3
Topologie générale	5
Travaux pratiques de théorie des probabilités	2
Options: choisir au moins 6 ECTS	
Algorithms and Complexity	3
Défis mathématiques par approches élémentaires	3
Didactique des mathématiques	4
Introduction à l'astronomie et à la géodésie	2
Mathématiques expérimentales	3
Mathématique physique	2
Physique expérimentale : physique moderne	4
Physique expérimentale : TD physique moderne	2
Physique mathématique : électrodynamique	4
Physique mathématique : TD électrodynamique	2
Total requis	30

PROGRAMME (2/2)

Cours	ECTS
Semestre 4	
Analyse complexe et compléments d'analyse réelle	5
Compléments de probabilités et statistique	3
Probabilités et statistiques	3
Options: choisir au moins 15 ECTS	
Analyse fonctionnelle	5
Analyse numérique	5
Courbes algébriques	5
Défis mathématiques par approches élémentaires	3
Didactique des mathématiques	4
Exercices de théorie des probabilités	3
Géométrie des courbes et surfaces	5
Histoire des sciences mathématiques	3
Introduction à l'analyse discrète	3
Introduction to geophysics: learning to think like a scientist	2
Introduction to graphics	4
Logiciels mathématiques	3
Mathématiques expérimentales	4
Relativité restreinte et mécanique quantique	3
Programming fundamentals	4
Techniques de l'expression	3
Théorie des nombres et applications à la cryptographie	5
Water resources: introduction and applied problems	3
Séminaire	2
Total requis	30

Semestre 5	
Semestre de mobilité	30
Total	30

Semestre 6	
Mémoire	12
Options: choisir au moins 18 ECTS	
Analyse fonctionnelle	5
Analyse numérique	5
Chaînes de Markov et files d'attente	3
Courbes algébriques	5
Défis mathématiques par approches élémentaires	3
Didactique des mathématiques	4
Histoire des sciences mathématiques	3
Introduction à l'analyse discrète	3
Introduction à la géométrie différentielle	5
Introduction to geophysics: learning to think like a scientist	2
Introduction to graphics	4
Logiciels mathématiques	3
Mathématique physique	3
Programming fundamentals	5
Techniques de l'expression	3
Théorie de la mesure et intégration	6
Théorie des nombres et applications à la cryptographie	5
Water resources: introduction and applied problems	3
Séminaire	2
Total requis	30



"The BASI-MATH gave me a solid basis in the core areas of mathematics. I especially liked the small class size which allows a lot of interaction between lecturers and students. Moreover, the supporting structure for doing an exchange semester is really well developed. I was able to use one of the many exchange agreements of the University and spent five months at one of the best universities in Japan."

Tara Trauthwein, graduate





Master in Mathematics

This Master offers a high standard programme with a flexible curriculum. Its array of choices leads to one of three career-driven directions: financial mathematics, general mathematics and industrial mathematics, preparing the students for their future career.

STRENGTHS

- Curricula designed in cooperation with representatives from industry and banks
- Teaching team committed to highest pedagogical quality
- Hands-on Luxembourg-based training and internships with selected partners

ADMISSION REQUIREMENTS

- Bachelor or equivalent with at least 180 ECTS in mathematics or similar discipline
- Language: B2 in English

CAREER OPPORTUNITIES

- Mathematicians are needed in all institutions and companies, including public sector and higher education institutions, banks, industries, etc.
- Further studies at PhD level

PROGRAMME AT A GLANCE

- **Duration:** 2 year full-time programme/ 4 semesters (120 ECTS)
- **Language:** English
- **Registration fees:** 200€/semester
- **Application period:**
 - For EU students: February - July
 - For non-EU students: February - April

ADDITIONAL INFORMATION

CONTACT

mmath@uni.lu

CAMPUS

Belval



mmath.uni.lu



"Due to the student projects, seminars and optional courses, I could gather experience in the topics I was most interested in while learning about general modern mathematical topics. During the internship and master thesis, I gained experience in a R&D department in the Luxembourgish industry, which helped me a lot to develop my skills and to decide my next career steps. Overall, the Master programme prepared me very well for the contemporary demands of the industry and opened a lot of career opportunities."

Steve Dias Da Cruz, graduate

PROGRAMME

Courses	ECTS
Semester 1	
Commutative algebra	8
Riemannian Geometry	8
Partial differential equations	8
Discrete-time stochastic processes	6
Stochastic Analysis	6
Numerical Analysis	6
Algorithmic Number Theory	4
Basics of Discrete Mathematics	4
Student project	4
Probabilistic Models in Finance	5
Mathematical Statistics	5
Graph Theory	3
Continuous Optimization and Coding	4
Total required	30

Semester 2	
Algebraic Topology	8
Riemann Surfaces	8
Algebraic Number Theory	6
Partial Differential Equations II	8
Advanced Graph Theory	6
Continuous Time Models in Mathematical Finance	8
Advanced stochastic models and financial applications	5
Numerical solution of PDEs and applications	6
Student seminar	2
High Dimensional Statistics	5
Optimality of tests and estimators in statistics	5
Numerical Methods for Variational Problems	5
Total required	30

Semester 3	
Option General Mathematics	
Introduction to Algebraic Geometry	6
Lie Algebras and Lie Groups	6
Combinatorial Geometry	6
Hyperbolic Geometry	6
Arithmetic Geometry	6
Student Group Project	2
<i>Courses from Track Financial Mathematics</i>	
<i>Courses from Track Industrial Mathematics</i>	

Option Industrial Mathematics	
Advanced Discretization Methods	5
Intelligent Systems - Problem Solving	3
Selected Topics in Industrial Mathematics	6
Combinatorial Geometry	6
Student Group Project	2
Gaussian processes and applications	6
Non-parametric statistics	5

Courses from Track Financial Mathematics

Courses from Track General Mathematics

Option Financial Mathematics	
Student Group Project	2
Numerical methods in Finance	5
Gaussian processes and applications	6
Continuous-Time Stochastic Calculus and Interest Rate Models	5
American Options: Optimal stopping theory and numerical methods	5
Advanced Econometrics	6
Non-parametric statistics	5
Advanced Discretization Methods	5
<i>Courses from Track Industrial Mathematics</i>	
<i>Courses from Track General Mathematics</i>	
Total required	30

Semester 4	
Option General Mathematics	
Master thesis at Uni.lu	20
Complex Geometry	5
Selected Topics in Mathematics	5
Option Industrial Mathematics	
Master Thesis with Internship	30
OR:	
Master Thesis	20
Selected Topics in Industrial Mathematics	5
Optional course	5
Option Financial Mathematics	
Master Thesis with Internship	30
OR:	
Master Thesis	20
Stochastic calculus of variations in Finance and Statistics	5
Selected Topics in Financial Mathematics	5
Internship in a financial institution	5
Total required	30



Master in Secondary Education Mathematics



The programme prepares students to become highly qualified teaching professionals in the Luxembourg school system. Students are enabled to further their knowledge in mathematics and to develop the skills needed for teaching in various classroom settings.

STRENGTHS

- Classes in applied didactics
- Classes in educational sciences and educational sociology and psychology
- Two three-week internships in a secondary school
- Compatibility with the reduction to 1 year of the Luxembourgish postgraduate education

OBJECTIVE

The programme puts a special focus on issues specific to Luxembourg, such as multilingualism, multiculturality and integration. Moreover, didactical courses given by high-school teachers and the two internships in secondary schools allow our students to enter the Luxembourgish school system early on.

ADMISSION REQUIREMENTS

- Bachelor in Mathematics
- Languages: English: level B1; French: level B2 and German: level B2

CAREER OPPORTUNITIES

- "Professeur de l'enseignement secondaire" in Luxembourg
- Working as a mathematician in industry or the financial sector



"This Master provided me with a strong basis in pure mathematics and a solid preparation for the exam (Concours de recrutement des enseignants-fonctionnaires). Several courses favoured a deep analysis of hands-on experiences, presented by professionals that work in the field, along with pre-planned internships that allowed me to experience working in front of a class for the first time."

Florence Zeyen, graduate

PROGRAMME AT A GLANCE

- **Duration:** 2 year full-time programme/ 4 semesters (120 ECTS)
- **Languages:** English (70%), French (15%), German (15%)
- **Registration fees:** 200€/semester
- **Application period:**
 - For EU students: February - July
 - For non-EU students: February - April

ADDITIONAL INFORMATION

CONTACT

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CAMPUS

Belval

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PROGRAMME

Courses	ECTS
Semester 1	
Mathematical Statistics	5
Graph Theory	3
Student project	4
Teaching secondary school mathematics	5
Einführung in die Schulpädagogik	5
Partial differential equations	8
Total	30

Semester 2	
Riemann Surfaces	8
Algebraic Number Theory	6
Advanced Graph Theory	6
Learning and teaching mathematics	5
Mehrsprachigkeit im Sprach- und Fachunterricht	3
Workshop zum Praktikum	2
Total	30

Semester 3	
Lie Algebras and Lie Groups	6
Combinatorial Geometry	6
Arithmetic Geometry	6
Student seminar	2
Applied didactics	5
Diagnostik - Differenzierung - Inklusion	5
Total required	30

Semester 4	
Master thesis	20
Learning and teaching mathematics	5
General professional competences	5
Total	30

The students should collect 60ECTS in mathematical courses, 20ECTS in didactical courses, 20ECTS in pedagogical courses, and 20ECTS with the Master Thesis (and the two internships in high-schools are compulsory). There is a lot of freedom in choosing the courses, for example any mathematical course which is suitable for any track of the Master in Mathematics is allowed.



Master of Data Science

(Starting in September 2021)

120 ECTS

Data scientists are trained as both mathematicians and computer scientists and their unique profile at the intersection of the two disciplines are highly sought. Based on a multidisciplinary approach, the Master programme will provide students with the necessary skills to solve complex problems with data in different contexts.

STRENGTHS

- High-level training
- Multidisciplinary approach
- Broad spectrum of skills & Variety of pedagogical tools
- International and multicultural environment
- Central place in Europe
- Low study cost

ADMISSION REQUIREMENTS

- Bachelor or equivalent with at least 180 ECTS in mathematics, physics, engineering or information technology
- Language: level B2 in English

CAREER OPPORTUNITIES

- Data scientists in all institutions and companies, including public sector and higher education institutions, banks, industries, etc.
- Doctoral Programme in Mathematics and Applications at the University of Luxembourg

PROGRAMME AT A GLANCE

- **Duration:** 2 year full-time programme/ 4 semesters (120 ECTS)
- **Language:** English
- **Registration fees:** 200€/semester
- **Available places:** 20
- **Application period:**
 - For EU students: February - July
 - For non-EU students: February - April

ADDITIONAL INFORMATION

CONTACT

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CAMPUS

Belval

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PROGRAMME

Courses	ECTS
Semester 1	
Mathematical Statistics	5
Optimization and Numerical Probabilities	5
Signal processing	3
Programming with R and PYTHON	5
NoSQL Databases & Cloud Computing	5
Data visualization	3
Applied Philosophy of Science and Data Ethics	3
Introduction to Graph Theory	3
Total	Min 30

Semester 2	
Fundamentals of Statistical Learning	5
Resampling methods and estimator selection	5
High Dimensional Statistics	5
Big Data Analytics	5
Introduction into Machine Learning Methods and Data Mining	5
Introduction to Biology for Data Scientists	5
Advanced Statistics	5
Prototyping with Deep-Learning	5
Total	Min 30

Semester 3	
Analysis of Complex Networks	5
About the optimality of tests and estimators in statistics	5
Parallel and Grid Computing	5
Computational methods	5
Nonparametric Statistics	5
Introduction to Computer Vision and Pattern Recognition	5
Network Analysis in Life Sciences	5
Econometry	5
Time series	5
Graphical Models and Causality	5
Introduction to deep learning	5
CART algorithm and Random Forest	5
Workshop I	5
Workshop II	5
Workshop III	5
Total required	Min 30

Semester 4	
Internship or master thesis	30
Total	30



"The Master's programme covers many aspects of data science, including data mining, data processing, data visualisation, statistical modelling and database management. Particular emphasis is placed on machine learning and deep learning techniques and their applications to life sciences, medicine and physics. The pedagogical approaches are varied and based on the practice of data science in each of these disciplines."

Prof. Yannick Baraud, course director



Doctoral Programme in Mathematics and Applications



This programme offers research training at an internationally competitive level in various mathematical disciplines, such as algebra and number theory, geometry and the mathematical theory of quantisation, harmonic and geometric analysis, probability theory and its applications, mathematical finance, and mathematical modelling.

STRENGTHS

- Close and personal supervision by internationally leading scientists
- Immediate integration into research groups and projects
- Attractive working conditions: competitive salary, travel support, located at Belval campus
- Benefits from the integration into the Doctoral School in Science and Engineering (DSSE)
- Broad offer of disciplinary, interdisciplinary and transferable skills training

ENTRY REQUIREMENTS

- Master's degree in Mathematics or a related subject

CAREER OPPORTUNITIES

Job Profiles

- Research & Development
- Teaching
- Consulting
- Analytics

PROGRAMME AT A GLANCE

- **Duration:** 36 to 48 months
- **Language:** English
- **Disciplinary and transferable skills courses (20 ECTS)**
- **Registration fees:** 200 €/semester
- **Number of doctoral candidates:** 24

Job Fields

- Finance, Banking and Insurance
- Information technology
- Data Sciences and Statistics
- Academia
- Public institutions

ADDITIONAL INFORMATION

CONTACT

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CAMPUS

Belval

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"The University of Luxembourg offers a wide spectrum of topics in mathematics, ranging from pure fundamental mathematics to interdisciplinary interactions with computer science, physics, biology and various other disciplines. The working environment is highly inspiring and dynamic, but also convivial."

Jill Marie-Anne Ecker, doctoral candidate



Department of Mathematics

During the last half of the 20th century, striking applications of mathematics appeared in all natural sciences, even in behavioural and social sciences. Mathematics is a universal tool to gain insight into highly complex systems. But mathematics is also a science of its own. It is highly alive, powered by its internal driving forces and by inspirations coming from new challenges in other fields. The Department of Mathematics (DMATH) carries out research in mathematics, both on its fundamental and its applied aspects.



DMATH at a glance

MEMBERS

- 14 professors
- 28 post-docs and research scientists
- 24 doctoral candidates
- 2 technical and administrative staff

FUNDING AND COLLABORATIONS

- €2.3 million acquired in new research projects (2020)
- FNR-funded COVID-19 research effort (€50000)
- H2020 ERC Consolidator Grant on Statistical Methods For High Dimensional Diffusions (€1.5 million)
- Esch 2022 exploratory project (€75000)

PUBLICATIONS

- 77 peer-reviewed articles in scientific journals (2020)

ADDITIONAL INFORMATION

CONTACT

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CAMPUS

Belval

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Research areas

ALGEBRA AND NUMBER THEORY

- Algebraic number theory
- Arithmetic geometry
- Computational and explicit number theory
- Kummer theory of algebraic groups
- Galois representations and modular forms

GEOMETRY & THE MATHEMATICAL THEORY OF QUANTIZATION

- Supergeometry and supersymmetry
- Derived algebraic geometry and differential operators
- Deformation quantization and Grothendieck-Teichmüller group
- Moduli spaces of Riemann surfaces
- De Rham field theories and multiple zeta values

GEOMETRIC TOPOLOGY & ANALYSIS

- Teichmüller theory
- Low dimensional geometry and topology
- Discrete and polyhedral geometry
- Analysis on locally symmetric spaces
- Representation theory of Lie groups

MATHEMATICAL MODELLING

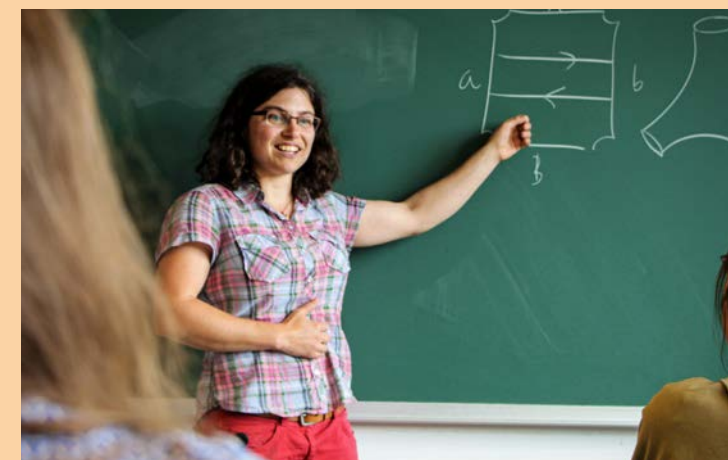
- Decision making and operations research
- Discrete mathematics and combinatorics
- Long-range dependence and self-similarity
- Rough differential equations
- System reliability theory

PROBABILITY THEORY & ITS APPLICATIONS

- Stochastic calculus and applications to finance
- Stochastic differential geometry
- Limit theorems and functional inequalities
- Stochastic differential equations
- Random fields and random geometric graphs

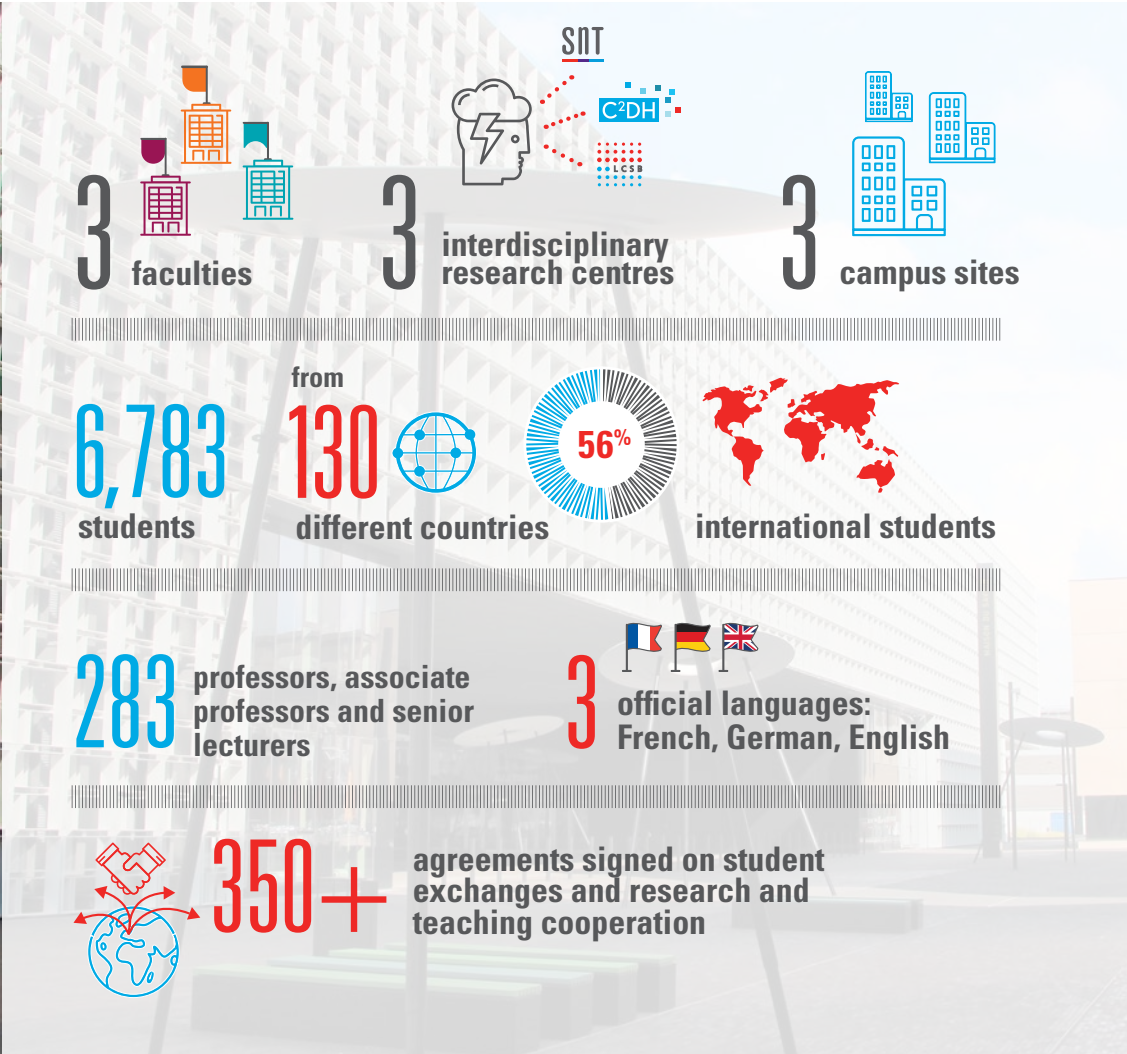
STATISTICS

- High-dimensional statistics
- Robust estimation
- Model selection
- Hypothesis testing
- Parametric and non-parametric statistics



Young, dynamic and international

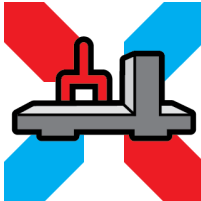
The University of Luxembourg is a European research-oriented university with a strong international and multilingual character. Founded in 2003, the university currently counts more than 6,000 students. Members of the university community come from all over the world.



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Three campus sites



Belval Campus
2 avenue de l'Université
L-4365 Esch-sur-Alzette



Kirchberg Campus
6 rue Richard Coudenhove-Kalergi
L-1359 Luxembourg



Limpertsberg Campus
162 A avenue de la Faïencerie
L-1511 Luxembourg



Great place to live and work



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EUROPEAN
INSTITUTIONS

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different nationalities
live side by side

A **dynamic, competitive** and
open economy with an attractive
labour market



Living in Luxembourg is
a unique **multilingual** and
multicultural experience



University of Luxembourg

■ Faculty of Science, Technology and Medicine

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University of Luxembourg
Multilingual. Personalised. Connected.

