

SCIENCES, TECHNOLOGIES AND HEALTH

# Master in Mathematics and applications

Mathématiques et applications



Target level  
Baccalaureate  
+5



ECTS  
120 credits



Duration  
2 years



Component  
Grenoble  
INP, Institut  
d'ingénierie et  
de management  
- UGA, UFR  
IM2AG  
(informatique,  
mathématiques  
et  
mathématiques  
appliquées)



Language(s) of  
instruction  
English, French

## Subprograms

- > Preparation for agregation (algebra, analysis, modeling)
- > Fundamentals mathematics
- > Operations Research, Combinatorics and Optimization (ORCO)
- > Cybersecurity
- > Statistics and data sciences (SSD)
- > Master in Science in Industrial and Applied Mathematics (MSIAM)



## Presentation

Below is a diagram (in French) of the structure of the master : on the left column, the first year masters (core curriculum), on the center and right columns the second year masters.

Co-accredited training between the Grenoble Alpes University, the Polytechnic Institute of Grenoble, and the University of Savoie Mont-Blanc.

This master courses offers several programs :

- Master in Science Industrial Applied Mathematics (MSIAM) : first year + second year
- Preparation for agregation : second year
- Cybersecurity (CybSec) : second year
- Fondamental mathematics : second year
- Statistics and data science (1) : first year + second year
- Operation Recherche Combinatorics and Optimization (ORCO) : second year
- Mathematical Modeling, Applied Analysis (MMAA) (2) : first year + second year

(1) Co-delivered by the Humanities and social sciences teaching department of Grenoble Alpes University

(2) Delivered by the Université de Savoie Mont Blanc

#### The master proposes two core curricula :

- General mathematics core curriculum in French
- Applied mathematics core curriculum in French and English

**Differentiation at first year level** : The optional teaching units proposed in semester 7 and semester 8 aim at guiding the students towards the various courses of the second year of the master. The Statistics and data science program is independent of the core curricula. The Mathematical modelling, Applied analysis program is also independent of the core curricula, but one can enter it at the second year level.

#### Differentiation of the courses at the second year level (Statistics and data sciences and Mathematical modelling, Applied analysis excepted) :

- The Master in Science in Industrial and Applied Mathematics, based on the core curriculum Applied mathematics accessible via the core curriculum General mathematics
- Fundamental mathematics, based on the core curriculum General mathematics
- Preparation for agregation, based on the core curriculum General mathematics
- Cybersecurity, accessible via the core curricula Applied mathematics and General mathematics, as well as via the core curriculum Computer science of the Computer science master program

- ORCO, accessible via the core curricula Applied mathematics and General mathematics, as well as via the core curriculum Computer science of the master program Computer science

The objective of this master is to train highly skilled specialists in mathematics and computer science for engineering, teaching, and research in a wide range of fields (pure and applied maths) where the demand from the socio-economic world is strong : security and cryptology, scientific computing, operational research, big data analysis, image synthesis and processing, statistics etc.

Several courses (MSIAM, CySec, ORCO) provide highly sought-after math/computing skills.

**Identifier ROME** : IT studies and development

## Skills

The basic courses (between 40 and 50 ECTS) are offered in French or English in the first year of the Master.

For research-oriented courses: body of general research-related competencies

- formulate a problem, establish a state of the art, estimate the feasibility, and the impact of a resolution of problem, establish, follow a strategy. Skills are acquired during TER, projects and internships research in M1 and M2 (> 30 ECTS). Discovery of the socio-economic world offered to all students through introductory modules to the company, project and industrial internships (at least 36 ECTS for career paths), the business forum (presentation of ~ 40 companies, interviews, tables rounds ...) and thematic conferences given by industry. All students also have access to language courses (English or French as a foreign language depending on their level, 6 ECTS)

**International education** : Double degrees, joint degrees, Erasmus Mundus, Education with formalized international partnerships, Internationally-oriented programmes

## International dimension

- Course CM-BHC in Erasmus Mundus

- CS course, MSIAM are entirely in English, international recruitment
- MF course taught in English according to the public, international recruitment

## Organisation

**Abroad internship** : In France or abroad

## Admission


### Access conditions

The first year master is open to students with a degree conferring the title of bachelor in a field compatible with the fields of the master, or with a validation of studies or of prior experience.

Admission to the second year's master is selective. It is open to candidates who completed a first year Master in the field.


**Continuing education** : You are in this situation if :

- you resume your studies after 2 years or more of interruption of studies
- or you followed a formation under the regime *Formation continue* during one of the 2 preceding years
- or you are an employee, job seeker, self-employed

If you do not have the diploma required to integrate the training program, you can undertake a  validation of personal and professional achievements (VAPP). (in French)

### Candidature / Application

Would you like to apply and register ? Then please be aware that the procedure differs depending on your diploma, on your degree, or on your place of residence for foreign students. For

more details, please follow this link (in French) :  <https://www.univ-grenoble-alpes.fr/candidater-et-s-inscrire/>

### Fees

Tuition fees 2019-2020 : 243 €

## And after

### Sector(s)

Activity areas : R & D, mathematical engineering in industry, public research, and education

### Targeted trades

The main opportunities for each standard programme are:

- Algebra, Analysis, Modelling, Teacher and Aggregation
- Preparation: mathematics teacher
- Master's in Science in Industrial and Applied Mathematics: researcher and teacher-researcher in applied mathematics
- R&D engineer in mathematics and industrial computing - technical and commercial engineer.
- CM-BHC: researcher and teacher-researcher in mathematics/computing applied to biomedical research
- Statistics and Data Sciences: statistical engineer - data-analyst - biostatistician - statistical programmer in industry and administration - technical-commercial and statistical engineer. R&D.
- ORCO: Operational Research Engineer - Logistics Engineering Engineer - Optimization Development Engineer - R&D Engineer in Operations Research - Teacher-researcher in Operations Research and Combinatorics.
- CS: engineer in cybersecurity - engineer in security of information systems - engineer specialized in auditing security of information systems - technical engineer in computer security - R&D engineer specialized in cybersecurity.
- Fundamental Mathematics: researcher and teacher-researcher in Mathematics, higher education.

- Mathematical Modelling, Applied Analysis: Modelling, optimization, decision support. Types of employers: Large enterprises and SMEs; Research and consultancy firms; Territorial authorities.

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## Additional information

Les principaux débouchés par parcours type sont :

- **AAM-Agreg** : enseignant de mathématiques
- **MSIAM**: chercheur et enseignant-chercheur (E-C) en mathématiques appliquées - ingénieur R&D en mathématique et informatique industrielle - ingénieur technico-commercial.
- **CM-BHC** : chercheur et E-C en maths/informatique appliquées à la recherche biomédicale
- **SSD** : ingénieur statisticien - data-analyst – biostatisticien - programmeur statisticien dans l'industrie et l'administration - ingénieur technico-commercial en statistique. R&D.
- **ROCO** : Ingénieur consultant Recherche Opérationnelle - Ingénieur technico-commercial en logistique - Ingénieur développement en optimisation - Ingénieur R&D en Recherche Opérationnelle - E-C en Recherche Opérationnelle et Combinatoire.
- **CS** : ingénieur en cybersécurité - ingénieur en sécurité des systèmes d'information - ingénieur spécialisé en audit sécurité des systèmes d'information - ingénieur technico-commercial en sécurité informatique - ingénieur R&D spécialisé en cybersécurité.
- **MF**: chercheur et E-C en Mathématiques, enseignement supérieur.
- **MMAA** : Modélisation, optimisation, aide à la décision. Types d'employeurs : Grandes entreprises et PME-PMI ; Sociétés d'études et de conseils ; Collectivités territoriales

## Useful info

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## Contacts

### Program director

Didier Piau

✉ [didier.piau@univ-grenoble-alpes.fr](mailto:didier.piau@univ-grenoble-alpes.fr)

### Program director

Sylvain Meignen

✉ [Sylvain.Meignen@grenoble-inp.fr](mailto:Sylvain.Meignen@grenoble-inp.fr)

### Program administration

Service de formation UFR IM2AG

✉ [im2ag-service-formation@univ-grenoble-alpes.fr](mailto:im2ag-service-formation@univ-grenoble-alpes.fr)

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## Course location(s) - City

📍 Grenoble

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## Campus

🏠 Grenoble - University campus

# Program

Preparation for agregation (algebra, analysis, modeling)

Fundamentals mathematics

Master in general mathematics 1st year

## Semester 7

	Nature	CM	TD	TP	Crédits
UE Algebra 1	Teaching Unit (UE)	26h	45,5h		9 credits
UE Holomorphic functions	Teaching Unit (UE)	19,9h	29h		6 credits
UE Ordinary differential equations	Teaching Unit (UE)	26h	45,5h		9 credits
UE Scientific English	Teaching Unit (UE)		24h		3 credits
UE Statistics	Teaching Unit (UE)				3 credits

## Semester 8

	Nature	CM	TD	TP	Crédits
UE Study and research work	Teaching Unit (UE)		25h		3 credits
UE Algebra 2	Teaching Unit (UE)	19,5h	29h		6 credits
UE Differential and dynamic geometry	Teaching Unit (UE)	19,5h	29h		6 credits
UE Functional Analysis	Teaching Unit (UE)	19,5h	29h		6 credits
UE Stochastic processes	Teaching Unit (UE)	19,5h	29h		6 credits

UE Computer algebra and cryptology

Teaching  
Unit (UE)

15h 6 credits

## Master 2nd year

### Semester 9

### Semester 10

	Nature	CM	TD	TP	Crédits
UE Research internship	Teaching Unit (UE)				27 credits
UE English	Teaching Unit (UE)				
UE LaTeX	Teaching Unit (UE)				3 credits

## Operations Research, Combinatorics and Optimization (ORCO)

### Master Industrial and applied math 1st year

### Semester 7

	Nature	CM	TD	TP	Crédits
UE Partial differential equations and numerical methods	Teaching Unit (UE)	18h	18h	18h	6 credits
UE Signal and image processing	Teaching Unit (UE)		4,5h	16,5h	6 credits
UE Geometric modelling	Teaching Unit (UE)	16,5h	4,5h	33h	6 credits
UE French as a foreign language	Teaching Unit (UE)				
UE English	Teaching Unit (UE)				

### Semester 8

	Nature	CM	TD	TP	Crédits
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UE Computing science for big data and HPC	Teaching Unit (UE)		18h		6 credits
UE Project	Teaching Unit (UE)				3 credits
UE Internship	Teaching Unit (UE)				3 credits
UE Numerical optimisation	Teaching Unit (UE)		18h		6 credits
UE Computer algebra and cryptology	Teaching Unit (UE)		15h		6 credits
UE Variational methods applied to modelling	Teaching Unit (UE)	18h	18h	18h	6 credits
UE 3D Graphics	Teaching Unit (UE)	18h	18h		3 credits
UE Operations research	Teaching Unit (UE)	15h	18h	3h	3 credits

## Master in General mathematics 1st year

### Semester 7

	Nature	CM	TD	TP	Crédits
UE Algebra 1	Teaching Unit (UE)	26h	45,5h		9 credits
UE Holomorphic functions	Teaching Unit (UE)	19,9h	29h		6 credits
UE Ordinary differential equations	Teaching Unit (UE)	26h	45,5h		9 credits
UE Scientific English	Teaching Unit (UE)		24h		3 credits
UE Statistics	Teaching Unit (UE)				3 credits

### Semester 8

	Nature	CM	TD	TP	Crédits
UE Study and research work	Teaching Unit (UE)		25h		3 credits

UE Algebra 2	Teaching Unit (UE)	19,5h	29h		6 credits
UE Differential and dynamic geometry	Teaching Unit (UE)	19,5h	29h		6 credits
UE Functional Analysis	Teaching Unit (UE)	19,5h	29h		6 credits
UE Stochastic processes	Teaching Unit (UE)	19,5h	29h		6 credits
UE Introduction to cryptology	Teaching Unit (UE)	15h	9h	9h	3 credits

## Master 2nd year

### Semester 9

	Nature	CM	TD	TP	Crédits
UE Advanced models and methods in operations research	Teaching Unit (UE)	36h			6 credits
UE Combinatorial optimization and graph theory	Teaching Unit (UE)	36h			6 credits
UE Optimization under uncertainty	Teaching Unit (UE)	36h			6 credits
UE Logistic and transport	Teaching Unit (UE)	18h			3 credits
UE Scheduling	Teaching Unit (UE)	18h			3 credits
UE Graph and discrete structures	Teaching Unit (UE)	18h			3 credits
UE Advanced heuristic and approximation algorithms	Teaching Unit (UE)	18h			3 credits
UE Advanced mathematical programming methods	Teaching Unit (UE)	18h			3 credits
UE Efficient methods in optimization	Teaching Unit (UE)	18h			3 credits
UE Parallel systems	Teaching Unit (UE)	36h			6 credits
UE Academic and industrial challenges	Teaching Unit (UE)	18h			3 credits



UE SAT/SMT Solving	UE	6h	6h	6h	3 credits
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## Semester 10

	Nature	CM	TD	TP	Crédits
UE Practicum	Teaching Unit (UE)				30 credits

## Cybersecurity

### Master Industrial and applied math 1st year

## Semester 7

	Nature	CM	TD	TP	Crédits
UE Partial differential equations and numerical methods	Teaching Unit (UE)	18h	18h	18h	6 credits
UE Signal and image processing	Teaching Unit (UE)		4,5h	16,5h	6 credits
UE Geometric modelling	Teaching Unit (UE)	16,5h	4,5h	33h	6 credits
UE French as a foreign language	Teaching Unit (UE)				
UE English	Teaching Unit (UE)				

## Semester 8

	Nature	CM	TD	TP	Crédits
UE Computing science for big data and HPC	Teaching Unit (UE)			18h	6 credits
UE Project	Teaching Unit (UE)				3 credits
UE Internship	Teaching Unit (UE)				3 credits
UE Numerical optimisation	Teaching Unit (UE)			18h	6 credits

UE Computer algebra and cryptology	Teaching Unit (UE)		15h		6 credits
UE Variational methods applied to modelling	Teaching Unit (UE)	18h	18h	18h	6 credits
UE 3D Graphics	Teaching Unit (UE)	18h	18h		3 credits
UE Operations research	Teaching Unit (UE)	15h	18h	3h	3 credits

## Master General mathematics 1st year

### Semester 7

	Nature	CM	TD	TP	Crédits
UE Algebra 1	Teaching Unit (UE)	26h	45,5h		9 credits
UE Holomorphic functions	Teaching Unit (UE)	19,9h	29h		6 credits
UE Ordinary differential equations and partial differential equations	Teaching Unit (UE)				
UE Scientific English	Teaching Unit (UE)		24h		3 credits
UE Statistics	Teaching Unit (UE)				3 credits

### Semester 8

	Nature	CM	TD	TP	Crédits
UE Study and research work	Teaching Unit (UE)		25h		3 credits
UE Algebra 2	Teaching Unit (UE)	19,5h	29h		6 credits
UE Differential and dynamic geometry	Teaching Unit (UE)	19,5h	29h		6 credits
UE Functional Analysis	Teaching Unit (UE)	19,5h	29h		6 credits
UE Stochastic processes	Teaching Unit (UE)	19,5h	29h		6 credits

UE Introduction to cryptology	Teaching Unit (UE)	15h	9h	9h	3 credits
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## Master 2nd year

### Semester 9

	Nature	CM	TD	TP	Crédits
UE Software security, secure programming and computer forensics	Teaching Unit (UE)	19,5h		19,5h	3 credits
UE Security architecture : network, system, key management, cybersecurity of industrial IT	Teaching Unit (UE)	42h	15h	21h	6 credits
UE Cryptographic engineering, protocols and security models, data privacy, coding and applications	Teaching Unit (UE)	36h	21h	21h	6 credits
UE Threat and risk analysis, IT security audit and norms	Teaching Unit (UE)	19,5h		19,5h	3 credits
UE Physical Security : Embedded, Smart Card, Quantum & Biometrics	Teaching Unit (UE)	48h	15h	15h	6 credits
UE Advanced cryptology/Advanced Security	Teaching Unit (UE)	15h		24h	6 credits

### Semester 10

	Nature	CM	TD	TP	Crédits
UE Research practicum (in company or laboratory)	Teaching Unit (UE)				30 credits

## Statistics and data sciences (SSD)

## Master in Science in Industrial and Applied Mathematics (MSIAM)

### Master Industrial and applied math 1st year

#### Semester 7

	Nature	CM	TD	TP	Crédits
UE Objected-oriented and software design	Teaching Unit (UE)			18h	3 credits

UE Applied probability and statistics	Teaching Unit (UE)	24h		24h	6 credits
UE Partial differential equations and numerical methods	Teaching Unit (UE)	18h	18h	18h	6 credits
UE Signal and image processing	Teaching Unit (UE)		4,5h	16,5h	6 credits
UE Geometric modelling	Teaching Unit (UE)	16,5h	4,5h	33h	6 credits
UE French as a foreign language	Teaching Unit (UE)				
UE English	Teaching Unit (UE)				

## Semester 8

	Nature	CM	TD	TP	Crédits
UE Computing science for big data and HPC	Teaching Unit (UE)			18h	6 credits
UE Project	Teaching Unit (UE)				3 credits
UE Internship	Teaching Unit (UE)				3 credits
UE Numerical optimisation	Teaching Unit (UE)			18h	6 credits
UE Computer algebra and cryptology	Teaching Unit (UE)			15h	6 credits
UE Variational methods applied to modelling	Teaching Unit (UE)	18h	18h	18h	6 credits
UE 3D Graphics	Teaching Unit (UE)	18h	18h		3 credits
UE 3D Graphics Complementary	Teaching Unit (UE)				3 credits
UE Operations research	Teaching Unit (UE)	15h	18h	3h	3 credits
UE Operations Research Complementary	Teaching Unit (UE)	18h			3 credits
UE Statistical analysis and document mining	Teaching Unit (UE)	16,5h	7,5h	9h	6 credits

## Master MSIAM-Modeling, Scientific Computing and Image analysis (MSCI) 2nd year

### Semester 9

	Nature	CM	TD	TP	Crédits
UE Advanced imaging	UE	18h			3 credits
UE An introduction to shape and topology optimization	UE	18h			3 credits
UE Congestion Phenomena and Compressibility for Granular Media	UE	18h			3 credits
UE Efficient methods in optimization	UE	18h			3 credits
UE Geophysical imaging	UE	18h			3 credits
UE GPU Computing	UE	9h		9h	3 credits
UE Level set methods and optimization algorithms with applications in imaging	UE	18h			3 credits
UE Model exploration for approximation of complex, high-dimensional problems	UE	18h			3 credits
UE Modeling seminar and projects	UE		36h	24h	6 credits
UE Numerical optimal transport and geometry	UE	18h			3 credits
UE Software development tools and methods	UE	9h		30h	3 credits
UE Wavelets and applications	UE	18h			3 credits

### Semester 10

	Nature	CM	TD	TP	Crédits
UE MA research project	UE				30 credits

## Master MSIAM-Data science 2nd year

### Semester 9

	Nature	CM	TD	TP	Crédits
UE Advanced algorithms for machine learning and data mining	UE	18h			3 credits
UE An introduction to shape and topology optimization	UE	18h			3 credits
UE Computational biology	UE	18h			3 credits
UE Data science seminar	UE	18h			3 credits
UE Efficient methods in optimization	UE	18h			3 credits
UE Fundamentals of probabilistic data mining	UE	13,5h		4,5h	3 credits
UE Geophysical imaging	UE	18h			3 credits
UE GPU Computing	UE	9h		9h	3 credits

UE Information access and retrieval	UE	18h			3 credits
UE Introduction to extreme-value analysis	UE	18h			3 credits
UE Kernel methods for machine learning	UE	18h			3 credits
UE Machine Learning for Computer Vision and Audio Processing	UE	18h			3 credits
UE Machine learning fundamentals	UE	18h	12h		3 credits
UE Model exploration for approximation of complex, high-dimensional problems	UE	18h			3 credits
UE Model selection for large-scale learning	UE	18h			3 credits
UE Modeling seminar and projects	UE		36h	24h	6 credits
UE Numerical optimal transport and geometry	UE	18h			3 credits
UE Software development tools and methods	UE	9h	30h		3 credits
UE Statistical methods for forecasting	UE	18h			3 credits
UE Stochastic calculus and applications to finance	UE	18h			3 credits
UE Wavelets and applications	UE	18h			3 credits

## Semester 10

	Nature	CM	TD	TP	Crédits
UE MA research project	UE				30 credits