# Advanced Mathematics
# MASTER 2 IN LYON
## 2024-2025

## FIVE THEMATIC PROGRAMS

- Refresher courses (late August ⇒ early September)
- Basic courses, first semester (September ⇒ December)
- Advanced courses, second semester (January ⇒ March)
- Research internship (April ⇒ July)

More info on the program, applications, scholarships ... available at
⤳ mathematiques.ens-lyon.fr

## PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS

### Basic Courses

- Evolutionary PDEs (Dragoş Iftimie)
- Calculus of variations and elliptic equations (Filippo Santambrogio)
- A few models and methods for life sciences (Thomas Lepoutre)

### Advanced Courses

- Optimal transport: introduction and overview (Cédric Villani)
- Random and stochastic reaction-diffusion equations (Julien Vovelle)
- On the non linear Schrödinger equation (Nikolay Tzvetkov)
- Semiclassical dynamics (Laurent Laflèche)

## PROBABILITY AND STATISTICS

Some courses are joint with the M2 program "Maths in action"
mastermas.univ-lyon1.fr/

### Basic Courses

- Stochastic calculus (Marielle Simon)
- Random walks (Thomas Budzinski)
- Concentration of measure in probability and high-dimensional statistical learning (Guillaume Aubrun, Aurélien Garivier, Rémi Gribonval)
- Stochastic modelization and statistical learning (Aurélien Garivier, Clément Marteau)

### Advanced Courses

- Graphs and ecological networks (Clément Marteau, Thibault Espinasse)
- Neural Networks (Aurélien Garivier)
- Optimal transport and learning (Filippo Santambrogio, Ievgen Reedko, Nicolas Bonneel)
- Inverse problems and parcimony (Yohann de Castro, Rémi Gribonval)
- Scaling limits of interacting particle systems (Oriane Blondel, Christophe Poquet)
- Spectral Theory of random operators (Raphaël Ducatez, Christophe Sabot)
- Phase transitions in spin systems (Christophe Garban)
- Scaling limits for stochastic processes: applications to biology (Hélène Leman and Céline Bonnet)

## NUMBER THEORY

### Basic Courses

- Local fields (Laurent Berger)
- Algebraic curves and elliptic curves (François Brunault)
- Modular forms (Sandra Rozensztajn)

### Advanced Courses

- $p$-adic modular forms (Benjamin Schraen)
- Bruhat-Tits tree of $SL(2)$ and non-Archimedean geometry (Bertrand Rémy)
- Elliptic curves in computational number theory (Benjamin Wesolowski)

## HIGHER ALGEBRA AND FORMALISED MATHEMATICS

### Basic Courses

- Algebraic rewriting and Categorification (Stéphane Gaussent and Philippe Malbos)
- Foundations of formalised mathematics and higher-dimensional rewriting (Georg Struth)
- Introduction to L∃∀N (Sophie Morel, Filippo A. E. Nuccio, Xavier-François Roblot)

### Advanced Courses

- Rewriting theory of higher algebras (Stéphane Gaussent, Philippe Malbos)
- Calculus of Inductive Constructions and Coq (Damien Pous)
- Advanced project on L∃∀N (Sophie Morel, Filippo A. E. Nuccio and Xavier-François Roblot)

## COMPLEX, ALGEBRAIC & SYMPLECTIC GEOMETRIES

*Topics in Complex, Algebraic, Kähler and Symplectic geometries*

### Basic Courses

- Introduction to Kähler geometry (Jean-Claude Sikorav)
- Introduction to Complex algebraic geometry (Antoine Etesse)
- Convexity in symplectic geometry (Klaus Niederkrüger)
- Reductive algebraic group over $\mathbb{C}$ (Jérôme Germoni)

### Advanced Courses

- GIT and Kempf-Ness theorem (Nicolas Ressayre)
- Symplectic capacities (Marco Mazzucchelli)
- Hermite-Einstein metrics and slope stability (Eveline Legendre)