

# Advanced Mathematics MASTER 2 IN LYON 2025-2026

## FOUR THEMATIC PROGRAMS

- Refresher courses (late August  $\Rightarrow$  early September)
  - Basic courses, first semester (September  $\Rightarrow$  December)
  - Advanced courses, second semester (January  $\Rightarrow$  March)
  - Research internship (April  $\Rightarrow$  July)
- $\rightsquigarrow$  Internship defences (end of August, early September)

More info on the program, applications, scholarships ... available at  
 $\rightsquigarrow$  [mathematiques.ens-lyon.fr](http://mathematiques.ens-lyon.fr)

It is possible to mix courses from different thematic programs (e.g. have a "major" and a "minor" theme).

## PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS

### Basic Courses

- Evolutionary PDEs (Dragoş Iftimie, Nikolai Tzvetkov)
- 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)
- Hyperbolic and parabolic partial differential equations: theory and approximation (Frédéric Lagoutière)
- Semiclassical dynamics (Laurent Lafèche)

## PROBABILITY AND STATISTICS

Some courses are joint with the M2 program "Maths in action"  
[mastermas.univ-lyon1.fr/](http://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 (Romain Azaïs, Aurélien Garivier, Clément Marteau)

### Advanced Courses

- Graphs and ecological networks (Clément Marteau, Thibault Espinasse)
- Stochastic Partial Differential Equations and application to turbulence theory (Igor Honoré, Laurent Chevillard)
- Neural Networks (Cédric Gerbelot, Aurélien Garivier, Rémi Gribonval, Julian Tachella)
- Optimal transport and learning (Aymeric Baradat, Nicolas Boneel, Titouan Vayer)
- Inverse problems and parcimony (Yohann de Castro, Rémi Gribonval)
- 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)

## TRANSCENDENCE

*... between number theory, differential equations and model theory.*

### Basic Courses

- Introduction to transcendental number theory (Boris Adamczewski)
- Linear differential equations (Julien Roques)
- Introduction to model theory,  $\omega$ -stability and  $o$ -minimality (Frank Wagner)

### Advanced Courses

- Diophantine approximation and transcendence theory (Anthony Poëls)
- An introduction to  $G$ -functions (Eric Delaygue)
- Model theory of differential fields of characteristic zero (Rémi Jaoui)

## 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)