

ENS Lyon 2019-2020 End of Year Report

1 Purpose

In this report I'll write about my experience at ENS Lyon during the 2019-2020 academic year. My stay ended up getting cut short in the wake of the COVID-19 pandemic; even so I ended up learning some valuable lessons, academic and otherwise, and made personal connections that I'll be striving to keep for the long haul.

For the sake of brevity I aimed to make this report complementary to the ones written by my predecessors, which can be found on this page.

2 Campus Accommodation

At some point after your application is accepted, likely in early June, you'll be sent an email asking to fill out a form related to campus accommodation.

From what I could gather, the ENS also provides accommodation to incoming students and other international students, because of how the French system works, students starting their first year at the ENS are actually in their third year of tertiary education, like you would be. As you'll quickly realise the school has two separate sites, one named after René Descartes and dedicated to the humanities, one named after Jacques Monod, dedicated to the sciences and in which maths lectures are held, the two are a ten-minute walk apart and each has its own separate accommodation blocks, and you'll be asked to express a preference over which site you'd rather to be housed in.

2.1 A Comparison

In the units in Descartes, where I ended up, you have your own (quite small) ensuite room with a bed, a desk, and a closet. The kitchen, which, it's important to mention, lacks an oven, is shared with 3-4 other people. The main pro of living in Descartes is without doubt the gardens adjacent to the accommodation blocks, from which you can also gain direct access to the main site of the university library. In the time I was there, the site also boasted the presence of the only open university restaurant, as the one in Monod was being renovated.

Most math students do however end up living in Monod, as the walk to lectures in the morning (which start at 8am) is undeniably shorter. The people I knew who lived there shared the whole living space with a second roommate.

Their kitchens similarly lacked an oven and, depending on the luck of the draw, their apartment had either zero, one or two terraces.

2.2 Campus Gym(s)

Each site has its own space dedicated to fitness activities, which is accessible once one has payed for membership to the sports society (Association Sportive or AS). When it comes to fitness equipment they are pretty neck and neck in their mediocrity, for instance barbells are shunned in favour of smith machines, so don't hold your breath for deadlifts and properly-done squats. Provided on each site are kettlebells of up to 16kg, adjustable dumbbells, a pull-up bar, dip bars, and various machines. The AS membership can also be worth it if you are looking to join one of the university societies dedicated to a particular sport. The Descartes site, for instance, includes matted space as well as some boxing equipment which are used by the MMA society, and both sites have large gymnasiums for sports such as basketball and badminton.

2.3 Social Events

The K-fet in Descartes is a space dedicated to social occasions. At the start of the year it hosted a weekly event (the "Festive") every Thursday night 10:30pm-3:00am, before it was shut down following noise complaints from the neighbourhood. Go figure. In case the event takes place again when you happen to be there, it has to be said that the ENS' small and tightly-knit student community and the cheesy french music made it fully worth going to.

The Monod site has its own place, where the vibe is more relaxed despite it being open 24/7. The Foyer, as it's called, is furnished with a number of couches and armchairs, and beer is available to be purchased on a self-serve basis.

3 Modules

The L3 (3rd year) modules are taught entirely in French. The choice of maths modules is relatively narrow: eight core modules, four per semester, are compulsory for home students, who in addition must pass at least one of three optional modules taught throughout the year. Each of the core modules consists of one lecture and one problem class (officially called TD or Travail Dirigé) per week, lasting two hours each, for the duration of the semester, i.e. 12 weeks. Problem classes are usually taught by a PhD student, who at the start of the session will hand out a problem sheet. Students are supposed to work on the problems for the length of the class, while the "TD-man" (the actual term used to designate the person teaching the class) periodically presents his/her solutions to selected problems on the board. Optional modules run the same way, but limited to 6 weeks, i.e. half a semester. Exam sessions happen twice every semester, you sit midterm exams after six weeks and final exams at the end of the module for core modules, while for optional modules there's just one exam at the end of the

six weeks. For core modules part of the weight of the mark is carried by your results on two assignments, or DM, "Devoirs Maison", one assigned in each half of the semester.

Here below was the list of modules when I attended classes.

3.1 1st semester

Algèbre 1: The course starts with a healthy dose of linear algebra. While some of it is reminiscent of material covered in MA251 Algebra I, the depth and rigour are of a different caliber. Topics in this section include linear forms, duality, bilinear forms and the tensor product. Then follows a section covering all the group material from MA249: Algebra II, i.e. normal subgroups, group actions and Sylow theorems. The course finishes off with some group representation theory, which I found particularly neat. The main focus is on working out the character tables for certain groups. One thing you'll definitely learn if you take this module is how to deal with quotient constructions, since they crop up all over the place.

Analyse Complexe: The start of this module repeats the complex analysis done in MA244 Analysis III, i.e. from the definition of a holomorphic function to Cauchy's formula for contour integrals. It then also covers significant parts of MA3B8 Complex Analysis, such as the maximum principle and other properties of holomorphic functions, the Poincaré group, the residue theorem, meromorphic functions, and series and products of holomorphic/meromorphic functions. It's fairly self-contained in its scope and doesn't have much overlap with the other core modules.

Intégration et Mesure is an introduction to measure theory, covering the definitions related to measured spaces, Carathéodory's theorem for extension of pre-measures, the three main convergence theorems for sequences of the type $\int f_n$, Fubini's theorem, and some L^p space theory to finish off, including Riesz's representation theorem and Hilbert bases for L^2 . It's worth noting that this module and the next have a lot of overlap when it comes to the functional analysis.

Topologie et Calcul Différentiel: Includes all the material covered in MA260 Norms, Metrics and Topologies, as well as some of the material in the 3rd year functional analysis modules such as Hilbert spaces and Banach spaces. This was my favourite course of the semester, single-handedly thanks to the lecturer Claude Danthony, whose explanations are as illuminating as his marking ruthless.

3.2 2nd semester

Algèbre 2: The first section on rings is similar to the corresponding material from MA249 Algebra II, with the inclusion of Noetherian rings and Zorn's Lemma. The module goes on to deal with field extensions and finally Galois theory. Self-contained but some of it is very beautiful and arguably something

every mathematician should know.

Analyse EDP: Begins with some of the material covered in MA250 Introduction to PDEs such as the transport equation and characteristic curves, but very quickly moves on to constructing weak solutions to non-linear transport equations. It also covers some distribution theory, which I found quite interesting, but at around this point I ended up dropping the module.

Calcul Différentiel 2: The first half of the module deals with ODEs in a similar way to MA254 Theory of ODEs, with things such as the Picard-Lindelöf theorem, the Gronwall inequality and Lyapunov functions. The second half deals with manifolds, although I also stopped following this module after midterms.

Intégration et Probabilités develops probability theory through the modern measure-theoretic approach. It deals with the Borel-Cantelli lemmas and other 0-1 laws, the law of large numbers, the central limit theorem, various definitions of convergence of random variables, random walks and Galton-Watson trees among others. My favourite module of the year that also sparked my interest in probability theory as a field of research.

One thing to note is many of the lecturers aren't interested in providing typed notes or past papers for their modules; however, one of my classmates ended up making his comprehensive \LaTeX notes available to the rest of the class. Please feel free to email me for access to this aforementioned treasure trove of knowledge, or for any questions and further enquiries you may have.