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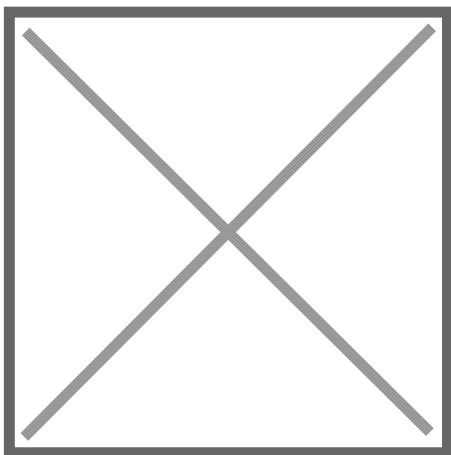
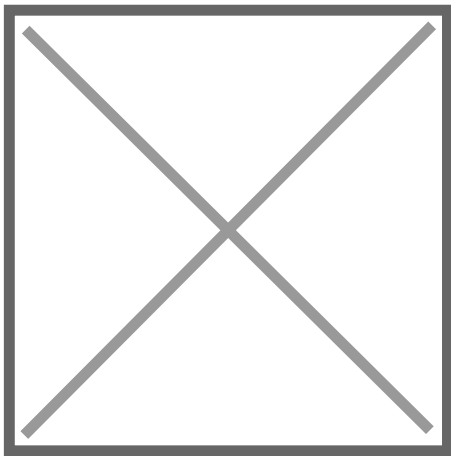
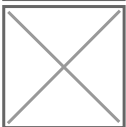
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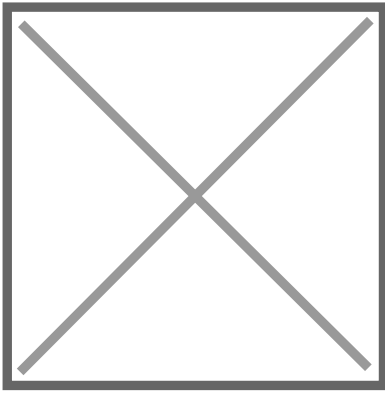
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Add to Compare

M2 Evolution of Genomes, Populations and Species: Data and Models (EvoGEM)





Master's degree

Specialisation Biodiversity, Ecology, Evolution

Enrolment type

Full-time academic programmes Life-long learning

Language(s) of instruction

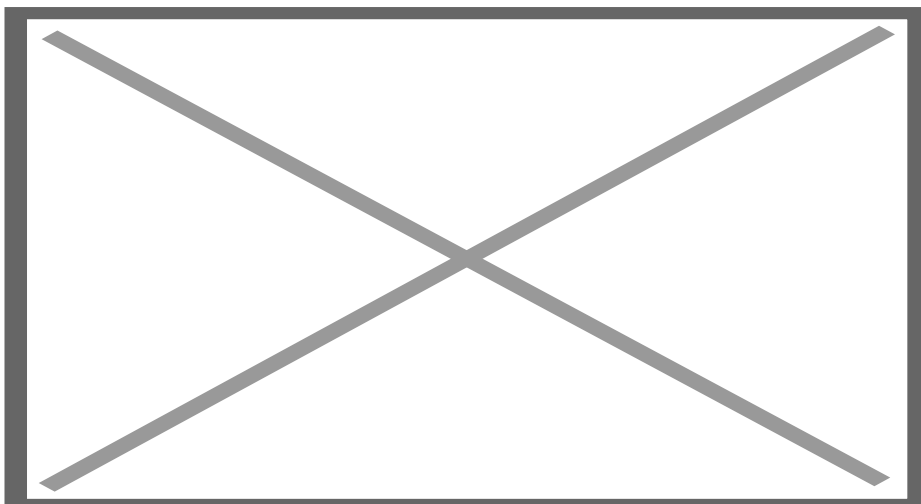
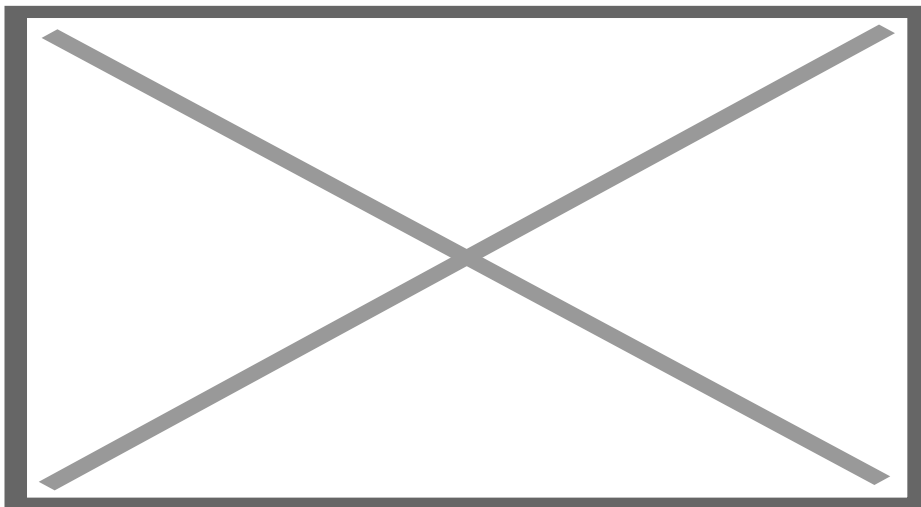
English French

2nd year Master's in Evolutionary Genetics

3 refresher TUs (Mathematics, Biology, Computer Science) without ECTS, 6 TUs in Semester 1 (Theory of evolution, Random models in ecology and evolution, Population genetics, Quantitative genetics, Comparative analyses in phylogeny, Advanced mathematics for evolutionary genetics, Cross-disciplinary project), followed by an internship in Semester 2.

[Télécharger la fiche détaillée](#)

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Information

- [Overview](#)
- [Application requirements](#)
- [Schedule](#)

Présentation

Skills

A robust and evolving general culture

Objectives

The genomic approach has revolutionised almost every field of life sciences, with applications in medicine, epidemiology, ecology, microbiology, plant breeding and conservation biology. More than ever, research in these fields relies on the evolutionary sciences and requires substantial theoretical and methodological developments. These developments are essential for integrating the complexity and heterogeneity of data, and for refining our understanding of evolutionary mechanisms within populations, species and ecosystems. The 2nd year Master's EvoGEM aims to acquire solid expertise in evolutionary genetics, with a specialisation in modelling, mathematics, bioinformatics and genomics. EvoGEM is being developed in collaboration with four other establishments in the Paris region. The involvement of researchers in the curriculum reinforces the curriculum-research continuum.

Débouchés

Career prospects

After a Master's or Master's + PhD: researcher or lecturer

After a Master's or Master's + PhD: engineer (research and development, control, production, etc.) in the fields of health, pharmaceuticals, agri-food, biotechnologies, instruments and reagents, cosmetics, pollution control and the environment.

Sectors of activity: fundamental or applied research in Biology, Health or Ecology in academia or the private sector

After a Master's + PhD: researcher or lecturer

Environment / Biodiversity Officer

Environment / Biodiversity Project Manager

Expert naturalist

Further Study Opportunities

PhD in Ecology / Evolution / Ecosystem Functioning

PhD in Ecology, Evolution

Admission

Capacity

Available Places

20

Target Audience and Entry Requirements

This curriculum is aimed at French and foreign students from universities and engineering schools in the fields of study of mathematics, computer science or biology, who have shown an interest in either biology or data modelling and processing, depending on their background. Students must therefore: * Have a 1st year Master's in life sciences or equivalent, and have good mathematical and computer competencies (programming and software use) or * Have a 1st year Master's in mathematics/physics/computer science, with a strong interest in biological issues.

Période(s) de candidature

Inception Platform

From 01/05/2026 to 30/06/2026

Supporting documents

Compulsory supporting documents

Motivation letter.

List of other masters requested (excluding Saclay).

All transcripts of the years / semesters validated since the high school diploma at the date of application.

Curriculum Vitae.

Detailed description and hourly volume of courses taken since the beginning of the university program.

Additional supporting documents

Letter of recommendation from a trainee.

VAP file (obligatory for all persons requesting a valuation of the assets to enter the diploma).

Supporting documents :

- Residence permit stating the country of residence of the first country
- Or receipt of request stating the country of first asylum
- Or document from the UNHCR granting refugee status
- Or receipt of refugee status request delivered in France
- Or residence permit stating the refugee status delivered in France
- Or document stating subsidiary protection in France or abroad
- Or document stating temporary protection in France or abroad.

Proof of comparability of diplomas (compulsory for students who can not justify a university degree)
<https://www.enic-naric.net/>.

Programme

Bloc 0 («Remise à niveau»)

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	practical class	directed study/practical class
Informatique (Info 0)	0	Semestre 1	2		21			



Informatique (Info 0)

ECTS : 0
 Semester: Semestre 1
 Detail
 Lecture: 2
 Practical study : 21
 Language(s) of instruction
 Anglais
 Remote teaching
 non
 Prerequisites

This programming course is intended for students from any background.

Programme/contents

Concepts covered include navigating and managing files under Unix, executing commands on the command line, and automating repetitive tasks. In Python, fundamental syntax, control structures (conditions and loops) and common data structures such as lists, tuples and dictionaries will be taught, as well as basics of programming in R, focusing on data analysis and manipulation, the use of packages, and the creation of reproducible scripts.

Learning objectives

This course introduces students to the basics of computer programming through the use of three essential environments: Unix, Python and R. This course aims to develop a practical understanding of programming tools and to foster autonomy in solving common computing problems.

Overall organisation

Location: Sorbonne Université, Campus Jussieu (Paris 5)

Type of assessment

Evaluation Continue non Intégrale

Mathématiques (Math 0)	0	Semestre 1	21	15
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Mathématiques (Math 0)

ECTS : 0

Semester: Semestre 1

Detail

Lecture: 21

Directed study: 15

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Expected mathematical proficiency after completing an M1 in Biology and a liking for and interest in mathematical formalism.

Programme/contents

Linear Algebra: Notions of matrices and vectors, matrix calculations, usual matrix properties, inversion, diagonalization.

Probability Basics: Random variables and common probability distributions, expected value and variance, convergence in distribution, central limit theorem, and law of large numbers. Properties of random vectors and matrices, Markov chains.

Statistics: Inference, likelihood, linear models, multivariate analyses (PCA, DFA, ...), introduction to Bayesian approaches.

Ordinary Differential Equations: Review of derivatives and integrals, concept of differential equations, solving a simple linear equation, system of differential equations, notion of dynamic equilibrium in systems.

Learning objectives

This teaching unit aims to consolidate/revise basic knowledge in mathematics and statistics. The objective is to recall the use of mathematical formalisms, especially matrix notation, review fundamental elements of probability and statistical inference, introduce Bayesian approaches, and revise basic concepts in the treatment of ordinary differential equations.

Overall organisation

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Biologie (Bio 0)	0	Semestre 1	13					
■								

Biologie (Bio 0)

ECTS : 0

Semester: Semestre 1

Detail

Lecture: 13

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

There is no pre-requisite for this course.

Programme/contents

Genetic basics – 2 h

Reproduction & heredity – 2h

Metabolism & Developpement- 2h

From genes to genomes – 3h

Regulation of gene expression – 2h

Systematic & biodiversity – 1h30

Conference – 2h

Learning objectives

This biology refresher course is intended for students from Mathematics and Computer Science backgrounds. It aims to acquire and/or consolidate basic knowledge in cellular and molecular biology, developmental biology, genetics, and genomics.

We also illustrate, through examples, how data derived from ‘omics’ technologies can address fundamental questions in evolutionary biology, as well as current challenges related to health and threats to biodiversity.

Overall organisation

Location: Sorbonne Université, Campus Jussieu (Paris 5)

Type of assessment

Evaluation Continue non Intégrale

Evolutionary Biology

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Théorie, modèle et explication scientifique en sciences de l'évolution (EVO)	3	Semestre 1	27					
■								

Théorie, modèle et explication scientifique en sciences de l'évolution (EVO)

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 27

Project : 3

Language(s) of instruction

Anglais

Remote teaching

non

Learning objectives

To propose a general framework for work in evolutionary biology, starting from a historical and epistemological approach and using examples from contemporary work to address the major issues of the 21st century. To understand how theories and models shape the constitution of data sets and, conversely, how data challenges established theories and models.

Overall organisation

Location: Museum National d'Histoire Naturelle (Paris 5)

Type of assessment

Evaluation Terminale

Génomes, Populations, eSpèces (GPS)	6	Semestre 1	34.5	6	7.5
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Génomes, Populations, eSpèces (GPS)

ECTS : 6

Semester: Semestre 1

Detail

Lecture: 34.5

Practical study : 7.5

Directed study: 6

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

- Biology basic knowledge.
- Genetics & mathematics fundamentals.

Programme/contents

- Evolution of genetic polymorphism at one locus in a neutral Wright-Fisher model.
- Consequences of diploidy and influence of mating systems.
- Multilocus polymorphism and recombination.
- Bayesian statistics in population genetics
- Polymorphism in meta-populations and speciation.
- Evolution of polymorphism under selection.
- Introduction to molecular evolution.

Learning objectives

This course will address the fundamental processes that are at work in evolution through the lens of population genetics and molecular evolution. It will devote time to statistical inferences based on the patterns of polymorphisms in sequence data. The intended participants are students motivated by the understanding of evolutionary processes and not entirely reluctant to theoretical models.

Overall organisation

Location: Ecole Normale Supérieure PSL and/or Collège de France (Paris 5)

Type of assessment

Evaluation Terminale

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Génétique Quantitative (GQ)	6	Semestre 1	24	24				

Génétique Quantitative (GQ)

ECTS : 6

Semester: Semestre 1

Detail

Lecture: 24

Directed study: 24

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

To be able to follow this course, there must be an understanding of Mendelian genetics and population genetics. Familiarity with linear models, probability theory, matrix algebra, R and/or is highly recommended.

Programme/contents

Heritability, additive genetic variance, infinitesimal model, relatedness, dominance, epistasis, linear mixed models, animal model, selection gradients and intensity, G matrix, M matrix, adaptive landscapes, genome-wide association analysis, genomic prediction, polygenic scores, polygenic adaptation

Learning objectives

This course offers an in-depth exploration of quantitative genetics, building on foundational knowledge in biology, mathematics, and genetics. It focuses on the genetic basis of complex traits influenced by many genes. Students will be introduced to core quantitative genetic models, including the partitioning of phenotypic variance and the concept of heritability. Key statistical approaches will be covered, such as the use of animal models to estimate variance components, and theoretical frameworks like the Price-Robertson identity to understand selection and evolutionary responses. The course will also delve into advanced topics including genomic selection, genome-wide association studies (GWAS), and multivariate evolution through the study of the G-matrix, M-matrix, and adaptive landscapes. Emphasis will be placed on the application of quantitative genetic tools in interpreting experimental evolution and investigating adaptation in natural populations, particularly in the context of global environmental

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class
Approches Comparatives Phylogénétiques (ACP)	6	Semestre 1	27		21			

Approches Comparatives Phylogénétiques (ACP)

ECTS : 6

Semester: Semestre 1

Detail

Lecture: 27

Practical study : 21

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Biology: basic knowledge of evolutionary processes (mutation, selection, genetics) and of biodiversity description (taxon, species, population).
Probability: Markov chains, likelihood

Programme/contents

- Database and alignments
- Phylogenetic inference : distances, maximum parsimony, maximum likelihood, bayesian inference, dating a phylogeny
- Phylogenomics and comparative genomics
- Post-tree analysis : species delimitation, ancestral state reconstruction and trait evolution, correlations, detecting selection, phylodynamics, diversification models
- Beyond trees : reticulated evolution, hybridization and introgression

Learning objectives

The aim of this module is to cover advanced notions in phylogenetics, from simple tree reconstruction algorithms to more complex phylogenomic methods. A great deal of the module will also cover post-phylogenetic analyses, such as trait evolution, diversification models or introgression detection.

Special teaching arrangements

Location: Université Paris-Cité, site Grands Moulins (Paris 13)

Type of assessment

Evaluation Terminale

Bloc 2 («Mathématiques»)

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	practical class	directed study/practical class	di
Modélisation mathématique Avancée pour la Génétique Evolutive (MAGE)	3	Semestre 1	27						

Modélisation mathématique Avancée pour la Génétique Evolutive (MAGE)

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 27

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Math 0 and MAEE (Stochastic Models in Ecology and in Evolution)

Programme/contents

Lecture 1 (AL): Cannings model, coalescent, infinite-site model, infinite-allele model, Ewens sampling formula, Chinese restaurant process.

Lecture 2 (SR): Multivariate methods: dimension reduction (PCA), clustering (hierarchical, k-means, mixture models).

Lecture 3 (AL): Brownian motion, diffusion theory, stochastic differential equations, infinitesimal generator, hitting probabilities, Feller diffusion, Wright-Fisher diffusion.

Lecture 4 (AL): Coupling gene genealogies: ancestral recombination graph, sequential Markov coalescent.

Lecture 5 (TMH): Mixed models : Random effects, ReML inference, hypothesis testing for variance components and random effect prediction (BLUP).

Lecture 6 (TMH): GWAS : Oligogenic and polygenic models, random effect model accounting for relatedness, multiple testing.

Lecture 7 (SR): State space models: hidden Markov models (HMM), STRUCTURE, sequence evolution models.

Lecture 8 (AL): coalescent of birth-death processes, Luria-Delbrück distribution, $1/k^2$ SFS.

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	di
Modèles aléatoires en Ecologie et en Evolution	3	Semestre 1	15	12					c

Modèles aléatoires en Ecologie et en Evolution

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 15

Directed study: 12

Language(s) of instruction

Français

Remote teaching

non

Prerequisites

- **Prerequisites:**

- A student enrolling in the course should know:
- what a matrix is and the elementary operations that apply to it (multiplication, diagonalization, inversion);
- what a discrete and continuous random variable is, and the related concepts (law, density, distribution function, expectation, variance);
- Knowledge of deterministic models of evolution, notably based on ordinary differential equations, is a plus;
- For those who are interested in the course but for whom these notions are unknown or remote, don't panic: you can acquire this knowledge by first taking the DYST module.\

Learning objectives

Contents:

Introduction to classical probabilistic dynamic models in ecology and evolution, i.e. Markov processes:

- in discrete time and space (Markov chains);
- in continuous time and discrete space (Poisson processes, birth and death);
- in discrete time and continuous space (Gaussian random walk);
- in discrete time and continuous space (Brownian motion and stochastic differential equations);

Goals:

Subjects	ECTS	Semester	Lecture	directed study	practical class	Lecture/directed study	Lecture/practical class	directed study/practical class	distance learning
Projet transversal (PRO)	3	Semestre 1	8						
■									

Projet transversal (PRO)

ECTS : 3

Semester: Semestre 1

Detail

Lecture: 8

Project : 12

Language(s) of instruction

Anglais

Remote teaching

non

Prerequisites

Bio0/Maths0/Info0 and EVO modules

Learning objectives

The aim of this cross-disciplinary module is to introduce students to working with data and models by means of a tutored project

Overall organisation

Location: Museum National d'Histoire Naturelle, Paris 5

Type of assessment

Evaluation Terminale

[Stage](#) 30 Semestre 2

■

Stage

ECTS : 30

Semester: Semestre 2

Language(s) of instruction

Anglais

Remote teaching

non

Type of assessment

Evaluation Terminale

Contact

- **Christine DILLMANN**
- **Pierre GERARD**

<http://www.universite-paris-saclay.fr/formation/master/biodiversite-ecologie-et-evolution/m2-evolution-des-genomes-des-populations-et-des-especes-donnees-et-modeles-evogem>