A unique mathematics community has once again been confirmed and outstanding with the announcement of the 12th French winner of the Fields Medal in 2014.

An observation made by French mathematician Marcel Berger, the internationally recognized expert in differential geometry, who has spent part of his working life in America and Japan, was confirmed in a survey carried out by the open web resource ScienceWatch in 2005. With the Institute of Advanced Scientific Studies (IHES, 5 Fields Medals), *École Normale Supérieure* (ENS, Paris), and the universities of Paris-Sud (3 Fields Medals), Pierre and Marie Curie (Paris 6), Paris-Diderot, Paris-Dauphine, and Paris-Est Créteil Val-de-Marne (UPEC), Paris and its surrounding area still represent the largest concentration of mathematicians in the world. Also of great importance are the universities of Bordeaux, Grenoble, Lyon, Marseille, Nice, Strasbourg, and Toulouse, with around forty shared research units with the National Center for Scientific Research (CNRS) and the National Institute for Research in Computer Science and Automation (INRIA).

**A long tradition of mathematics**

The century of Louis XIV was also that of Descartes, Fermat, and Pascal. At the time of the Revolution, Laplace, Lagrange, Legendre, Condorcet, d’Alembert, and Monge were the leading figures in mathematics. They, in turn, were followed by Fourier, Cauchy, Galois, Poncelet, and Chasles – a line of succession just as impressive, if less often invoked, as that linking France’s writers. We forget that at the outset of the 19th century more renowned foreign scholars arrived in Paris for its scientific culture than for its literary daze. By the end of the century and into the early 20th century, the capital hosted prominent personalities such as Jordan, Borel, Lebesgue, and Lévy, among others or a genius such as Poincaré, whose portrait photographed by Smith was first published in October 1889 in the *American Journal of Mathematics*.

The 1930’s saw the founding of the Bourbaki group, which revolutionized Mathematics, preparing the way for the prodigious expansion of the 1950’s and beyond. The reasons for that expansion are many: an increase in the theoretical research that underpins practical applications in every economic sector, in parallel with the explosion of computer science and robotics; the “mathematisation” of economic analysis; the flexibility and diversity of the system of mathematical research, which had been freed from some of the constraints of the university system by the emergence of other sources of financing; the autonomy of mathematical researchers, who are less dependent on large budgets than researchers in some other disciplines; the arrival in France of Russian mathematicians; the prestige in France of pure intellectual research; and the commitment of great mathematicians to the freedom of thought and criticism such as Alexandre Grothendieck (1928-2014), who was stateless for a long time before being made a French national in 1971 and who was trained and worked in France. Considered the greatest mathematician of the twentieth century, he turned down the Fields Medal in 1966 on political grounds.

Over 4 000 mathematicians work in the academic sector in France, and around 10% are researchers in public research organizations such as the National Center for Scientific Research (CNRS), the National Institute for Research in Computer Science and Automation (INRIA), and the National Institute for Statistics and Economic Studies (INSEE).
Interactions between mathematics and its new fields of application

As in many other fields, the distinction between pure and applied science has lost much of its validity: the chaos theory of Poincaré, the risk theory of American Frank Knight, and probability and statistical theory are of widespread and compelling interest to economists, political decision makers, insurance companies, military planners, and business leaders. No one in a position of major responsibility can afford not to take the careful look that mathematics makes possible. The mathematical approach and its methods can be used in various scientific disciplines, including automation, computer science, electronics, physics, engineering, and information, communication technologies, social sciences and health.


- A French-American study demonstrated that the spread of epidemics can be better understood by using mathematical models for air transportation.
- Meteorologists use Mathematics to understand atmospheric mechanisms and to analyze and anticipate changes in the weather and the climate.
- Advances in Physics, are inconceivable without high-level mathematics. The geometry of the universe poses fundamental problems, as do applications of chaos theory in Astrophysics.
- Crystal symmetries may be explained by very sophisticated algebraic theories. Biology uses attractors similar to those defined by the dynamical systems of chaos theory. Mathematical models in Ecology (predators and preys) reveal interactions that lie at the origin of species.

The Fields Medal: 13 of the 56 winners have come from French research institutions

The Fields Medal is the most prestigious international honor in mathematics, awarded every four years since 1936 to mathematicians under the age of 40. The first French mathematician to receive the award in 1950 was Laurent Schwartz, alumnus of École Normale Supérieure and professor at École Polytechnique. More recent medalists serve as proof of continued excellence in French mathematics, including Laurent Lafforgue (2002), an alumnus of École Normale Supérieure (ENS) and professor at the Institute of Advanced Scientific Studies (IHES), Wendelin Werner (2006), professor at Paris-Sud 11 University and École Normale Supérieure, Cédric Villani, director of the Henri Poincaré Institute in Paris (Pierre and Marie Curie University–UPMC-CNRS) and professor at École Normale Supérieure in Lyon, and Ngô Bảo Châu, professor at Paris-Sud University. On August 13, 2014, the Fields Medal was awarded to the French-Brazilian mathematician Artur Avila, director of research at the Jussieu-Paris Rive Gauche Institute of Mathematics (CNRS-Paris Diderot University-UPMC) and working at the Rio de Janeiro Institute of Pure and Applied Mathematics. His award thus confirms France’s place on the international podium, second only to the United States (14 winners).

Created in 2003, the Abel Prize has already been awarded to three French mathematicians:

Research units and Doctoral Departments

In France, there are more than 140 mathematics laboratories and research units and 17 doctoral schools in mathematics: For a list of all French mathematics research laboratories, see: https://www.portail-math.fr/laboratoires

Bordeaux Doctoral Department of Mathematics and Computer Science (EDMI Bordeaux) – ED 39
Bordeaux University’s EDMI operates in collaboration with the Bordeaux Institute of Mathematics (UMR 5251) and the Bordeaux Computer Science Research Laboratory (UMR 5800) in association with CEA-CESTA (the Aquitaine Center for Scientific and Technical Studies), ENSEIRB-MATEMECA (the Bordeaux National Department of Electronics, Computer Science, Telecommunications, Mathematics, and Mechanics), and INRIA (the Bordeaux South-West Research Center). Their research focuses on three areas: pure mathematics, applied mathematics and scientific calculus, and computer science. http://www.math.u-bordeaux1.fr/ED/ecole_doctorale/

Cergy Economics, Management, and Mathematics (EM2C) – ED 405
Doctoral Department 405 is multidisciplinary and is shared by the AGM (Analysis, Geometry, and Modeling) and THEM (Economic Theory, Modeling, and Applications) laboratories and affiliated to Cergy-Pontoise University. It is also co-accredited by ESSEC and its research center. The five laboratories conduct research in analysis, geometry and modeling, economic theory, and public, environmental, and development economics. http://www.collegedocotoral.u-cergy.fr

Computer Science, Automation, Electronics-Electrotechnics, Mathematics (IAEM Lorraine) – ED 77
The IAEM Lorraine Doctoral Department operates in collaboration with 11 laboratories, the CNRS Mixed Research Units and research teams, and the Charles Hermite Laboratories Federation. In addition to disciplinary applications, its research covers medical imaging, systems design and modeling, industrial engineering, and models and simulations for architecture and heritage. http://www.iaem.uhp-nancy.fr

Health, Information, Communication, Mathematics, and Materials (SICMA) – ED 373
This institution is co-accredited by the Universities of West Brittany (UBO) and South Brittany (UBS) plus Télécom Bretagne. It is also associated with the Bret National Engineering School, the Higher National School of Armament Studies and Technologies, and the Saint Cyr Special Military School. Around 20 laboratories develop applied research in molecular electrochemistry, functional genomics and biotechnologies, mechanics and systems, magnetism, spectrometry and laser optics, medical information processing, materials engineering, and movement in sport. http://edsicma.univ-brest.fr

Information and Mathematics Sciences and Technologies (STIM) – ED 503
This institution is coordinated by Nantes University and co-accredited by Nantes École Centrale, the Nantes École des Mines, and the Universities of Angers and Maine Le Mans. Around 10 laboratories conduct applied research in electronics and telecommunications, cybernetics, and electrical energy. http://edstim.univ-nantes.fr

Information Sciences and Engineering and Mathematics (S2I) – ED 521
This Department is part of the Limousin Poitou-Charentes Universities and Institutions Community. It is supported by Limoges University and operates six laboratories. It covers the disciplinary fields of mathematics, microwaves, photonics, computer science, imaging, and automation as well as the interactions among them. http://www.cue-lpc.fr/Ecole-Doctorale-Sciences-et.html

Lyon Computer Science and Mathematics (INFOMATHS) – ED 512
Attached to Lumiére Lyon 2 University, this institution is co-accredited by the Lyon École Centrale and the National Institute of Applied Sciences. Its seven laboratories conduct research in telecommunications, information systems, production systems, knowledge engineering, parallelism, modeling, probability, and statistics. http://edinfomaths.univsiete-lyon.fr

Marseille Mathematics and Computer Science – ED 184
Co-accredited by Aix-Marseille University and Marseille’s École Centrale, this institution is associated with Toulon University. It has three laboratories: the Marseille Institute of Mathematics (12M - UMR 7373), the Foundational Computer Science Laboratory (LiF - UMR 7279), and the Information and Systems Sciences Laboratory (LISIS - UMR 7296). It also runs two INRIA projects at Sophia-Antipolis in the field of automation. http://ed184.lif.univ-mrs.fr
Mathematics, Computer Science, Theoretical Physics, and Systems Engineering (MIPTIS) – ED 551
The MIPTIS Doctoral Department at Tours University operates in collaboration with five laboratories in conducting research in mathematical applications in physics, foundational computer science, and systems, mechanical, and energy engineering. http://recherche-valorisation.univ-tours.fr>Recherche>Écoles Doctorales

Mathematics and Information and Communication Sciences and Technologies (MSTIC) – ED 532
The MSTIC Doctoral Department is coordinated by Paris-Est University, bringing together 11 laboratories for research in scientific calculus, topographic information, microsystems, networks, terrestrial transportation, simulators, geomatics, intelligent systems and signals, image processing, and stereoplottin. http://www.univ-paris-est.fr/fr/-ecole-doctorale-mathematiques-et-stic-mstic-ed-532/

Mathematics, Information Sciences, and Engineering (MSII) – ED 269
Co-accredited by the Universities of Strasbourg (unistra) and Haute Alsace (UHA), this institution is associated with the Strasbourg National School of Water and Environmental Engineering (ENGEES) and the Strasbourg National Institute of Applied Sciences. It has eight laboratories conducting applied research in engineering, computer, and imaging sciences, design engineering, physical and mechanical textiles, modeling, intelligence, processes, and systems. http://ed.math-spi.unistra.fr

Mathematics, Information Science and Technology, Computer Science (MSIII) – ED 217
The MSIII Doctoral Department at Grenoble Alpes University brings together around 10 laboratories including the Institut Fourier (Pure Mathematics laboratory). Its mathematics, ICT, and computer science research has many scientific applications in design and production, microelectronics, integrated systems, and medical engineering. http://edmsiti.ujf-grenoble.fr

Mathematics, Telecommunications, Computer Science, Signals, Systems, and Electronics (MATISSE) – ED 359
The MATISSE Doctoral Department in the International Doctoral College of the European University of Brittany (UEB) is supported by Rennes University with Agrocampus Ouest, Rennes’ École Normale Supérieure, the Rennes Institute of Applied Sciences, Supéléc, Rennes 2 University, and Télécom Bretagne and works in association with the National School of Statistics and Information Analysis and the INRIA Rennes-Bretagne Atlantique Center. Its five laboratories conduct research in electronics and telecommunications, computer science and random systems, and signal and image processing. http://matisse.ueb.eu

Paris Center for Mathematical Sciences – ED 386
This Doctoral Department brings together mathematics and computer science laboratories from the Pierre and Marie Curie and Paris Diderot universities, the Paris École Normale Supérieure, and a number of research teams associated with INRIA. It is co-accredited by Paris Sciences et Lettres – Quartier Latin. Some 12 laboratories conduct research in statistics, multidisciplinary modeling, probability and random models, algorithmic computer science, systems programs, celestial mechanics and ephemeresis calculations, and social mathematics. http://www.ed386.upmc.fr

Paris-Sud Mathematics – ED 142
Attached to Paris-Sud University and the Department of Mathematics in the Faculty of Sciences at Orsay, this institution works in association with École Normale Supérieure in Paris. Its research focuses on harmonic analysis, digital analysis, algebraic arithmetic, and geometry, probability and statistics, and topology and dynamics. http://www.math.u-psud.fr/~ecdoct/ecdoct

Physical Sciences, Engineering Mathematics, and Information (SPMII) – ED 351
This multidisciplinary doctoral school is part of the Normandy Universities and Institutions Community (COMUE). It is attached to Rouen University and co-accredited by the Rouen National Institute of Applied Sciences and Le Havre University. Around ten laboratories develop research in aero-thermochemistry, materials physics, safety of chemical procedures, information and systems processing, structural mechanics, electrotechnology and automation, and waves. http://www.normandie-univ.fr>Collège doctoral>Écoles doctorales

Toulouse Mathematics, Computer Science, and Telecommunications (MITT) – ED 475
Attached to Toulouse University, this institution works in association with INPT-INSAT, the Toulouse National Institute of Applied Sciences, the Higher Institute of Space and Aeronautics, and the National School of Civil Aviation. The 13 research teams are interconnected and develop research in mathematics (algebra, analysis, geometry, probability, statistics, scientific calculus, optimization, partial differential equations), computer science and telecommunications (image analysis and synthesis, indexing, human-machine interactions, reasoning, decision, networks, architectures, software security, signal processing), and clinical epidemiology. http://www.edmitt.ups-tlse.fr
Useful links

Learned societies (Sociétés Savantes)
These associations gather together the majority of mathematicians in France for various activities, projects, colloquia, discussions, thematic group meetings, publications, and prize-givings and collaborate with research organizations:

Federations
- Denis Poisson Federation (Orléans): www.fdpoisson.fr
- FRUMAN, Marseille Mathematical Units Research Federation: http://frumam.cnrs-mrs.fr

Key organizations and institutions
- CERMICS, Teaching and Research Center for Mathematics and Scientific Calculus (Marne-la-Vallée): http://cermics.enpc.fr
- I2M, Marseille Institute of Mathematics: https://www.i2m.univ-amu.fr
- IRMA, Institute of Advanced Mathematical Research (Strasbourg): wwwirma.u-strasbg.fr
- Lagrange Laboratory (Nice): https://lagrange.oca.eu
- LJK, Jean Kuntzmann Laboratory (Grenoble): www-ljk.imag.fr
- LMBA, Bretagne Atlantique Laboratory of Mathematics (Brest, Vannes): www.lmba.math.cnrs.fr

Other sites
- Directory of mathematical research laboratories and units: https://www.portail-math.fr/laboratoires
- E-math.fr, the website for mathematics in France: www.emath.fr
- International Mathematical Union (IMU): www.mathunion.org
- MATEXO, pedagogical resources for higher education mathematics professors: http://matexo.sma.math.cnrs.fr
- M4TH, Portal dedicated to members of the higher education mathematics teaching and research community: https://www.portail-math.fr
- Fields Institute for Research in Mathematical Sciences: www.fields.utoronto.ca

A complete list of Doctoral Departments in France can be found online at www.campusfrance.org/en
The online catalog provides direct links to the research units within each Doctoral Department. A bilingual (French and English) search engine enables users to obtain results by selecting from among 20,000 keywords and 80 disciplinary themes. Departmental profiles are also provided.
Statistics and data processing

Statistics plays a role in many research domains. It is defined as “the collection and representation of data” (constructing categories and naming them) and is used most extensively in surveys carried out in France by major national institutions such as INSEE and INED. Descriptive (or exploratory) statistics works on raw data to try and extract meaning, structures, patterns, and laws. Inferential statistics is based on the notion of a probabilistic model for developing mathematical tools with which to compare a scientific model or hypotheses and experimental or observational data.

Statistics is situated both within mathematics, from which it borrows many tools (geometry, analysis, calculus, algebra) while also creating its own mathematical objects, and outside of mathematics, with applications in many fields (biology, physics, economics, social sciences). The specificity of statistics is that it also attempts to model induction, although some mathematicians do not regard statistics as being within the realm of mathematics (Patrice Bertail, "Statistique et recherches en France: Quelques perspectives," Insee-CREST, Courrier des Statistiques, 117-119, 2006).

Statistics has made major advances in French universities and research institutions, a development linked to a considerable demand for statistics and probability, which are strongly represented in French research and enjoy a flourishing and internationally recognized reputation. Researchers from applied research institutions such as INRA or INSERM thus have a dual competence, and higher education institutions such as ENSAE, ENSAI, and ISUP train students in specific domains of application.

Labex Ecodec is a laboratory of excellence that gathers together research professors in economics and statistics:

http://labex-ecodec.fr

- Center for Secure Data Access (CASD): http://casd.eu
  The CASD offers researchers a facility designed for working on highly detailed individual data. Access to the data is usually subject to a confidentiality agreement and is provided under optimal conditions of high security. More than 500 researchers participate in over 200 research projects.
- National School of Statistics and Information Analysis (ENSIAI): www.ensai.fr

The CNRS National Institute of Mathematical Sciences and their Interactions (INSMI)

INSMI’s mission is to promote excellence in French mathematics built on a solid basis consisting of:

- 50 shared Research and Service Units (principally university laboratories);
- 13 Research Federations (regional associations of laboratories);
- 9 International Mixed Units, 6 International Associate Laboratories, 7 groups combining European and international research;
- 3,200 researchers and research professors and 1,200 doctoral and postdoctoral researchers.

www.cnrs.fr/insmi