

Research in Mathematics in France



**« More than any other city on the planet,
Paris is the world's center for mathematics... »**

**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 7), 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 dazzle. 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 "*mathematicization*" 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).

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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.

Partial differential equations model phenomena in Climatology, Population dynamics, Economics, Environment, Finance, and Mechanics.

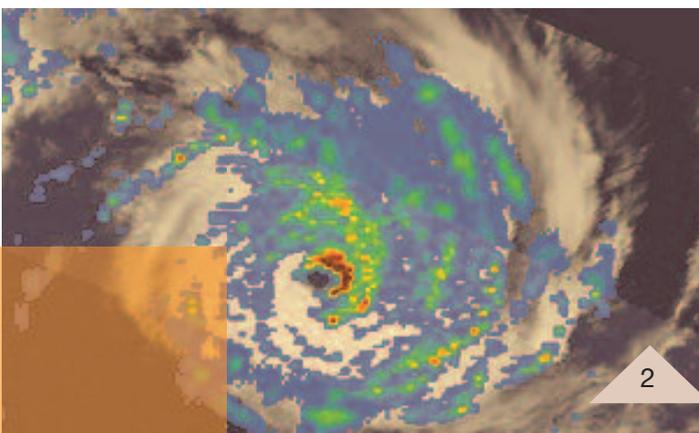
- A French-American study demonstrated that the spread of epidemics can be better understood by using mathematical models for air transportation.
- Meteorologists use Mathematics to understand atmospheric mechanisms and to analyze and anticipate changes in the weather and the climate.
- Advances in Physics, 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.

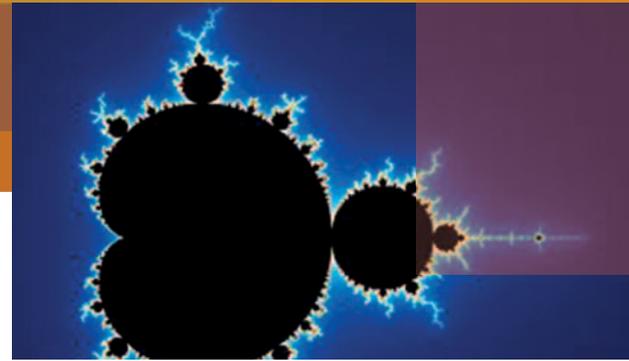
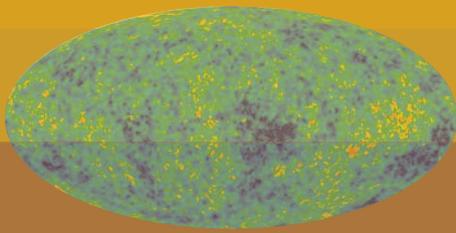
The Fields Medal: 13 of the 56 winners have come from French research institutions

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 Ávila, 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:

Jean-Pierre Serre of *Collège de France* (2003), who also won the Fields Medal at the age of 28, Jacques Tits (2008), joint laureate with the American John Griggs Thompson of *Collège de France*, and Franco-Russian Mikhail Leonidovich Gromov (2009), professor at the Institute of Advanced Scientific Studies (IHES).





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-MATMECA* (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 *THEMA* (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.collegedoctoral.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 Brest 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

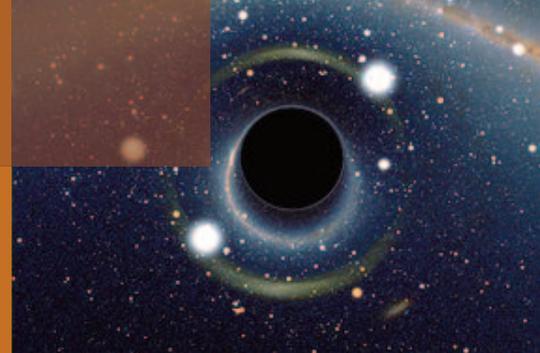
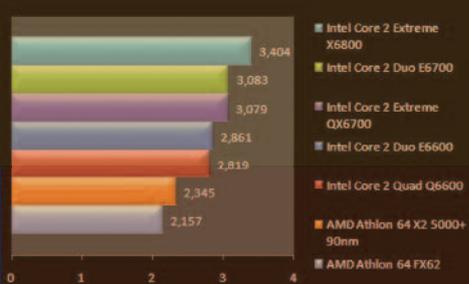
This Doctoral Department is part of the Limousin Poitou-Charentes Universities and Institutions Community. It is supported by Limoges University and operates six laboratories. It covers the disciplinary fields of mathematics, microwaves, photonics, computer science, imaging, and automation as well as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

Lyon Computer Science and Mathematics (INFOMATHS) – ED 512

Attached to Lumière 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.universite-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 (*I2M - UMR 7373*), the Foundational Computer Science Laboratory (*LIF - UMR 7279*), and the Information and Systems Sciences Laboratory (*LSIS - 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 stereoplotting. <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 (MSTII) – ED 217

The *MSTII* 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://edmstii.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, *Supélec*, 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 ephemeris 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, colloquiums, discussions, thematic group meetings, publications, and prize-givings and collaborate with research organizations:

- Society of Applied and Industrial Mathematics (*SMAI*): <http://smai.emath.fr>
- French Mathematical Society (*SMF*): <http://smf.emath.fr>
- French Statistical Society (*SFds*): www.sfds.asso.fr

Federations

- ARC Mathematics (Amiens): <http://arcmath.math.cnrs.fr>
- Bézout Research Federation (Labex Bézout): <http://bezout.univ-paris-est.fr>
- Denis Poisson Federation (Orléans): www.fdpoisson.fr
- Évry Val d'Essonne Mathematical Research Federation (Paris): www.math-evry.cnrs.fr
- FCH, Charles Hermite Automation, Computer Science, and Mathematics Federation of Lorraine (Metz, Nancy): www.hermite.univ-lorraine.fr
- FLMSN, Lyon Modeling and Digital Sciences Federation (Lyon): <https://flmsn.univ-lyon1.fr>
- FRMNPC, Nord Pas-de-Calais Mathematical Research Federation (Lille): <http://federation-math.univ-lille1.fr>
- FRMPL, Pays de Loire Mathematical Research Federation (Angers, Le Mans, Nantes): www.fpl.math.cnrs.fr
- FRMRAA, Rhône-Alpes-Auvergne Mathematical Research Federation (Clermont-Ferrand, Grenoble, Lyon): <http://frmraa.math.cnrs.fr>
- FRUMAN, Marseille Mathematical Units Research Federation: <http://frumam.cnrs-mrs.fr>
- Paris Central School Mathematics Federation (Chatenay-Malabry): www.ecp.fr/fedemaths
- Inner Paris Mathematical Sciences Research Federation: www.federation.math.jussieu.fr
- IPRA, Multidisciplinary Institute of Applied Research in Oil Engineering: <http://migp.univ-pau.fr>
- NM, Normandy Mathematics Federation (Caen, Le Havre, Rouen): <http://normandie.math.cnrs.fr>

Key organizations and institutions

- CAMS, Center for Social Analysis and Mathematics (Paris): <http://cams.ehess.fr>
- CERMICS, Teaching and Research Center for Mathematics and Scientific Calculus (Marne-la-Vallée): <http://cermics.enpc.fr>
- CIMPA, International Center for Pure and Applied Mathematics (Nice): www.cimpa-icpam.org
- CIRM, International Center for Mathematical Engagement (Marseille): www.cirm.univ-mrs.fr
- CMAP, Center for Applied Mathematics (Palaiseau): www.cmap.polytechnique.fr
- CMLA, Center for Mathematics and its Applications (Cachan): www.cmla.ens-cachan.fr

- CMLS, Laurent Schwartz Mathematics Center at École Polytechnique (Palaiseau): www.centremaths.polytechnique.fr
- ENS, École Normale Supérieure, Paris, Department of Mathematics and Applications: www.math.ens.fr
- ICJ, Camille Jordan Institute (Lyon, Saint-Étienne): <http://math.univ-lyon1.fr>
- IECL, Élie Cartan Institute of Lorraine (Vandœuvre-lès-Nancy): <http://iecl.univ-lorraine.fr>
- IHES, Institute of Advanced Scientific Studies (Bures-sur-Yvette): www.ihes.fr
- IHP, Henri Poincaré Institute – Home of Mathematics and Theoretical Physics (Paris): www.ihp.fr
- IMB, Bordeaux Institute of Mathematics: www.math.u-bordeaux1.fr/imb
- I2M, Marseille Institute of Mathematics: <https://www.i2m.univ-amu.fr>
- I3M, Montpellier Institute of Mathematics: www.mathfds.univ-montp2.fr
- Jacques Hadamard Mathematics Research Library (Orsay): <http://hip.math.u-psud.fr>
- INRIA, National Institute for Research in Computer Science and Automation: www.inria.fr
- INSMI, National Institute of Mathematical Sciences and their Interactions (Paris): www.cnrs.fr/insmi
- IRMA, Institute of Advanced Mathematical Research (Strasbourg): www-irma.u-strasbg.fr
- Lagrange Laboratory (Nice): <https://lagrange.oca.eu>
- LAMA, Laboratory of Applied Analysis and Mathematics (Marne-la-Vallée): <http://umr-math.univ-mlv.fr>
- LAMA, Laboratory of Mathematics (Annecy, Chambéry): www.lama.univ-savoie.fr
- LJK, Jean Kuntzmann Laboratory (Grenoble): www-ljk.imag.fr
- LMAP, Laboratory of Mathematics and its Applications (Pau): <http://lma-umr5142.univ-pau.fr>
- LMBA, Bretagne Atlantique Laboratory of Mathematics (Brest, Vannes): www.lmba-math.fr
- Toulouse Institute of Mathematics: www.math.univ-toulouse.fr
- UMPA-ENSL, Unit of Pure and Applied Mathematics (Lyon): www.umpa.ens-lyon.fr

Other sites

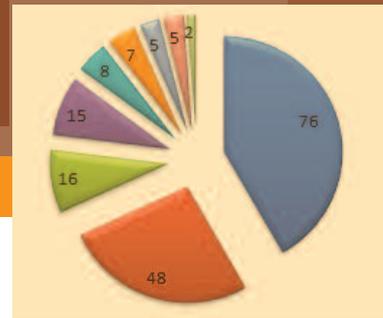
- Directory of the French mathematical community: <http://annuaire.emath.fr>
- Directory of mathematical research laboratories and units: <https://www.portail-math.fr/laboratoires>
- Directory of masters in mathematics: <http://masters.emath.fr>
- *E-math.fr*, the website for mathematics in France: www.emath.fr
- International Council for Industrial and Applied Mathematics (ICIAM): www.iciam.org
- International Mathematical Union (IMU): www.mathunion.org
- MATEXO, pedagogical resources for higher education mathematics professors: <http://matexo.smai.emath.fr>
- M4TH, Portal dedicated to members of the higher education mathematics teaching and research community: <https://www.portail-math.fr>
- European Mathematical Information Service: <http://emis.u-strasbg.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.



www.campusfrance.org/en Find your course > level D



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.

- Center for Research in Economics and Statistics (CREST): www.crest.fr
- National School of Statistics and Economic Administration (ENSAE ParisTech): www.ensae.fr
- National School of Statistics and Information Analysis (ENSAI): www.ensai.fr
- ENSAI-ENSAE Further Training (CEPE): www.lecepe.fr
- National Economics and Statistics Schools Group (GENES): www.groupe-genes.fr
- National Institute of Demographic Studies (INED): www.ined.fr
- National Institute of Statistics and Economic Studies (INSEE): www.insee.fr
- UPMC Institute of Statistics (ISUP): www.isup.upmc.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