MATHEMATICS

2009

Like certain other great disciplines (physics, chemistry, technology, computer science, economics, biology, medicine, the humanities), mathematics occupies a central place in the contemporary scientific world and the modern economy. It plays an essential role, for example, in the modeling tools used by other disciplines. Though this fact often goes unnoticed, mathematics is omnipresent in our technological society. Examples include the use of arithmetic in coding and cryptography, wavelet analysis in image-compression algorithms (such as the JPEG 2000 standard), partial derivative equations and numerical methods in weather forecasts, and stochastic computations in finance.

The need for mathematical competence is present in many professions—among highly qualified workers and technical personnel, for example, as well as executives in industry, public administration, business, and engineering.

Fields :
Mathematics, applied mathematics, statistics.
Also see the following subject profiles: Engineering, Computer science, Humanities, Biology, Physics.

Sectors:
The discipline of mathematics permeates various specialized fields, all of which have been touched by the digital revolution. These include statistics and finance, of course, as well as nuclear energy, biology, insurance, the social sciences, and new information technologies.

The speed of development and variety of uses of mathematics, moreover, have cast doubt on the old distinction between its pure and applied forms.
From junior statistician to professor of mathematics, from actuary to consulting engineer—mathematics is central to attractive careers in research, consulting, engineering, media (TV, film, Web, multimedia), banking and finance, automobiles, telecommunications, high technology, laboratory analysis, and manufacturing

ORGANIZATION OF STUDIES IN FRANCE

Degree programs of all types are available: short and long, basic and applied. In licence programs, opportunities to transfer from mathematics to computer science or statistics (or vice versa) are plentiful.

Among the universities with strength in mathematics are the University of Paris (Paris 6, Paris 11, Cergy-Pontoise) and several regional universities (Grenoble 1, Nancy 1, Toulouse 2). Most mathematics research is done in university laboratories, but other institutions have research strengths as well—among them certain grandes écoles and special-purpose institutions such as the IRD (Institut de recherche pour le Développement, institute of development research), the CEA (Commissariat à l'Energie Atomique, atomic energy commission), CEMAGREF (Institut de recherche pour l'ingénierie de l'agriculture et de l'environnement, institute for research in agricultural and environmental engineering), LCPC (Laboratoire Central des Ponts et Chaussées, central laboratory of the national school of bridges and roads), INRETS (Institut National de recherche sur les Transports et leur Sécurité, national institute for research in transportation and transportation safety), and INSEE (Institut national de la Statistique et des Etudes économiques, national institute of statistics and economic research).

Universities
Depending on the university, various mathematics-related majors, or concentrations, are available under the 3-year licence program in science and technology. A major in mathematics prepares students for two paths: pursuit of a master's degree or entry into a career. Licence degrees in general mathematics, often coupled with some training in statistics or numerical analysis, are valued by banks, insurance companies, and industry. The universities strive to offer a diverse range of programs that will suit those who wish to acquire solid basic knowledge, as well as those who prefer to gain a broad overview of the field.

Schools and specialized institutes
• Ecole Normale Supérieure (Paris, Cachan, Lyon, Cachan Bretagne)
Within the framework of its policy of international relations and interuniversity exchanges, ENS holds an annual admission competition for international students in the sciences. The competition is open to exceptional students currently enrolled in their second, third, or fourth year of university study (usually the final year of the first stage of university education). The department of mathematics admits students only in their second or third year. Students study for 3 years, during which time they are paid a stipend
• Ecole Polytechnique: training in general mathematics
• Ecole des Mines ParisTech, Ecole des Ponts ParisTech, Ecole Centrale Paris, Ecole TELECOM ParisTech: engineering curriculum.
Unlike the universities, which have a policy of open enrollment in the first year, the grandes écoles have the legal right to select the students whom they will admit, either by means of an entrance examination or on the basis of the applicant's record and an interview.

Some of the grandes écoles recruit students directly from secondary school and offer them 2 years of general education before beginning the specialized curriculum. Others recruit students from elite 2-year programs known as classes préparatoires aux grandes écoles.

Preparing for scientific studies in France

• FILIPÉ http://www.e-filipe.org/

A special program of linguistic preparation for study in France, FILIPÉ, developed by a large consortium of university science programs, enables prospective international students in their first two years of postsecondary education to begin preparing online and from home for their intended study of science in France. Students learn to understand instruction in French in a specific field of science, technology, or engineering so as to make better use of their classroom time once they arrive in France.

RESEARCH THEMES

Basic mathematics

Large, unsolved problems often turn out to be engines of scientific advancement. They are often linked, loosely or directly, to pending questions in other sciences, and their solution may give rise to unexpected applications. Some examples follow in which French mathematicians played a key role: classification of low-dimensional varieties; the Langlands program; algebraic cobordism; and the ongoing merger of algebraic topology and algebraic geometry. On the other side of the great problems, new ideas regularly arise, such as techniques of concentration of measure, hypoelliptic calculus, optimal transport, and wavelet theory.

Interdisciplinary interactions

The large questions in fields in which mathematics provides important conceptual tools are a major source of new challenges for the discipline. Reciprocally, mathematical theories often find their most eloquent expression, or fulfillment, outside mathematics. Examples include partial derivative equations; algebraic and combinatorial structures; geometric structures; probabilistic aspects of statistical mechanics and thermodynammics; noncommutative probabilities; the consistency of certain theories in physics; theories of complexity and proof; and statistics. In addition to physics and computer science, other domains, including chemistry, biology, engineering, and information science, involve major mathematical problems

Modeling and computation

Operational mathematics produces quantitative results for technological applications. Examples include modeling based on partial derivative equations; stochastic and statistical modeling; optimization and control; signal and image processing; and scientific computing

Broad fields of application

Some of the broad fields in which mathematics is applied are chemistry and materials (quantum chemistry and process engineering); biology and medicine (neurosciences, image processing, fluid and structural mechanics, statistics, discrete mathematics); genomics (statistical analysis, automated sequencing procedures); problems of energy and the environment (storage of wastes, climate change, natural catastrophes); transportation (aeronautics, automobiles, road traffic management); decision support (financial mathematics, actuarial methods, operational research); telecommunications and data transmission (coding, cryptology, electromagnetism, network queues; nanotechnologies).

INTERNATIONAL STANDING

In no other discipline is France's international status so clearly eminent as in mathematics. Indeed, the French school of mathematics is among the strongest in the world, as confirmed by multiple indicators. Mathematics is the only discipline in which France is ranked second in the world (behind the United States) by the Web of Science. Of the 48 Fields medals awarded since 1936 (the highest honor for mathematicians under the age of 40), 12 went to French mathematicians or mathematicians working in France. Eight of those were graduates of the Ecole Normale Supérieure. Laurent Lafforgue won the Fields in 2002. Four years later, the medal went to Wendelin Werner, a professor at Paris-Sud 11 and a specialist in probability calculs. French mathematicians have captured other prestigious prizes as well, among them the Clay, Abel, and Crawford prizes.

Beyond these many honors and high rates of publication and citation, the great strength of French mathematics lies in its simultaneous engagement in all branches of the discipline and in the uniform level of excellence of that engagement. France's mathematicians are a close-knit and well-structured community, thanks to the cooperative efforts of academic departments, learned societies, the CNRS, and the Ministry of Higher Education and Research

▶ Websites

• CampusFrance http://www.campusfrance.org
• Centre national de la recherche scientifique (CNRS, national center for scientific research), http://www.cnrs.fr
• Mathematics portal, http://www.portail-math.fr/
• The Mathematical Sciences Foundation of Paris http://www.sciencesmaths-paris.fr/
• Collège de France http://www.college-de-france.fr/

Learned societies
• SMF, French mathematical society http://smf.emath.fr/
• SMAI, society for applied and industrial mathmatics http://www.emath.fr
• French statistical society http://www.sfds.asso.fr/
• European Mathematical Society (EMS), http://www.emis.de/

Institutes and centers for scientific exchange
• The Institut des Hautes Etudes scientifiques (IHES, institute for advanced scientific research) is a research center organized around several exceptional investigators. The institute maintains an extensive and prestigious program under which international visitors are invited to the institute for prolonged stays http://www.ihes.fr/
• The Institut Henri Poincaré (IHP), known as "the house of mathematicians and physicists" organizes semester-long programs of events on various themes. http://www.ihp.jussieu.fr/
• The Centre international de rencontres mathématiques, Marseille (CIRM, international mathematics center of Marseille) organizes weekly scientific meetings on a given subject or problem http://www.cirm.univ-mrs.fr/
• The Centre international de Mathématiques Pures et Appliquées (CIMPA, international center for pure and applied mathematics), in Nice, promotes mathematics and its applications in developing countries through the organization of thematic seminar series. http://www.cimpa-icpam.org/index.php
• Directory of mathematics laboratories and centers http://math-doc.ujf-grenoble.fr/Annuaires/
• Directory of the French mathematics community http://annuaire.emath.fr/

▶ Keywords

actuarial science – administration – agri-food – algebra – algorithms – analysis – applications – applied mathematics – arithmetic – atmosphere – basic sciences – biology – biostatistics – body – calculus – chemistry – climate – clinic – code – cognition – communication – computer science – computer security – consulting – control – cryptography – cryptology – data analysis – demography – design – development – data – dynamic – ecology – economics – econometrics – energy – engineering – enterprise – environment – equations – expertise – experimentation – reliability – fibers – finance – fluids – graphics –genome – geometry – geophysics – health – history – humanities – image – industry – informatics – information theory – insurance – investment – law – logic – management – materials – mathematics –financial mathematics – microelectronics – modeling – fluid mechanics – mechanics – multimedia – networks – numbers – numeric – optimization – optics – philosophy – physics – probability – programming – random – research – risk – social sciences – signal – simulation – software – solids – statistics – systems – technology – telecommunications