The language of science and the study of practical problems.

Mathematics is one of the oldest fields of human intellectual endeavor. As technology emerges, mathematicians are increasingly involved in practical problem solving.

When studying abstract concepts, applied and pure mathematics are strongly linked. Significant breakthroughs in physical and computational sciences, as well as the data revolution have given rise to a plethora of challenges in the field of applied mathematics. Its applications are varied: statistics for finance and environmental sciences; powerful data compression algorithms for communication systems; simulation of blood flow using numerical methods.

The master in Applied Mathematics provides students with all the advanced skills needed in various fields, such as Statistics, Probability or Scientific Computing.
Cardiovascular simulations

Prof. Deparis
A better understanding of vascular flow is of crucial importance to better assess the risks associated to a specific pathology. Thanks to numerical simulation it is possible to provide flow indices which may help in the decision making for surgery. For example, in presence of an Abdominal Aortic Aneurism (AAA), the surgeon has to decide upon intervention. Access to patient specific numerical simulations allows to better evaluate the opportunity of an intervention.

From the modeling point of view, the blood flow is described by the Navier-Stokes equations and the arterial wall by specific non-linear elastic laws. The finite element method is a perfect tool to correctly approximate the vascular flows. Mathematics is important to ensure the coupling between fluid and structure, but also to control the accuracy of the simulation. Since the non-linear system involves a huge number of unknowns, it is also necessary to devise parallel algorithms for its resolution.

Extreme wind storms

Prof. Davison
Often the risk for human infrastructure or insurance portfolios due to extreme windstorms is based on catalogues of events that are used as 'stress tests'. These catalogues usually consist of historical records or are artificially generated by climate models, and can have severe limitations when estimating the risk of events even more severe than those previously seen.

Stochastic weather generators are mathematical models that create random but realistic events which could be used to enlarge or even create catalogues. Extreme value theory describes the statistical behavior of extreme events and provides a mathematical framework to extrapolate above the intensity of historical records. These approaches have been used to develop a generator of extreme European wind storms that can simulate events of unprecedented severity, such as the one shown below. The new methods can be used to understand the impact of climate change on extreme events and thus help to assess the exposure of current infrastructure to climatological risk, as well as helping to plan for the future.
Master of Science in
APPLIED MATHEMATICS

2-year program - 120 ECTS

Students must choose at least 30 ECTS worth of courses labelled A.

Optional courses are classified in the following tracks:
- Algebra and geometry
- Algorithmic and discrete mathematics
- Analysis
- Numerical analysis
- Probability and interactions
- Statistics

On top of the Optional courses (40 ECTS) students must choose 4 ECTS in another engineering program, except if they opt for a 30 ECTS engineering minor.

Recommended courses:
- Applied biomedical signal processing
- Signal processing for communications
- Statistical signal and data processing through applications
- Applied data analysis
- Algorithms
- Advanced algorithms
- Information theory and coding
- Investments
- Quantitative risk management
- Principles of microeconomics
- Relativity and cosmology I
- Relativity and cosmology II

Students opting for a minor in engineering may shorten their industrial internship.

School of Basic Sciences
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