

# All part of the equation

Enrique Zuazua, Scientific Director at the Basque Center for Applied Mathematics, heralds the role of applied mathematics in times of crisis...

The demand for mathematical sciences is rapidly increasing. Although often ignored, a quick look to existing and emerging scenarios in areas such as industrial design, biomedical sciences, computers and informatics, telecommunications, robotics, economy, energy, social sciences or climate change, provide clear indicators of the increasingly important role that mathematics is playing in all aspects of modern society.

Galileo was the first to say: "The universe is written in the language of mathematics." The shape and structure of the newly born 21st Century is the best proof of how right he was. Even he would be surprised to see the extent to which time has confirmed his celebrated saying.

But, what is mathematics? Mathematics and language are probably the main building blocks of modern society and the most complex and beautiful constructions of humankind. This science, first created to describe, quantify and analyse the simplest shapes and mechanisms of nature, is now on the way to addressing the most sophisticated issues ranging from the explanation of mechanisms that generate complex patterns (as pigmentation or texture on skins of animals) to the theoretical reasons for the behaviour of societies in what concerns, for instance, opinion formation.

Many people identify mathematics with its origins: numbers and geometric shapes. But modern mathematics has diffused boundaries and a significant intersection with other sciences ranging from physics to biology, from engineering to computer sciences, and from economy to culinary arts – all are experiencing an impressive growth in the knowledge society in which we live. Mathematics is benefiting tremendously from this mutual interaction; new problems in these disciplines require and demand the development of new mathematics. In this way, they bring new and interesting problems that motivate the development of new methods, and, in addition, new technologies allow the implementation of techniques that, until now, were mere abstract artefacts. That happens, for instance, in the Systems Control Theory. This complex scenario of multidisciplinary interaction explains why, nowadays, we often refer to applied mathematics as the ensemble of scientific developments and methods originated from mathematics, covering all areas of sciences, and strongly influenced by the development of computational methods and informatics.

This being so, the increasingly significant role of mathematics is still frequently ignored or underestimated.

For instance, paradoxically, university students often don't see maths courses as attractive and wrongly believe that the job market is rarely interested in mathematicians. But the real scenario is precisely the opposite. Pursuing maths studies is probably one of the best bets during this time of crisis when facing the job market.

Mathematics is continuously evolving to face these new challenges, and to also address its own inner issues. Indeed, it is not free from criticism or contradiction, and this has already been the case: the Pythagorean School, devoted to explaining nature through rational numbers (quotients of integer numbers), discovered that the length of the hypotenuse of a rectangular triangle of sides of unit length is the square root of two, an irrational number. The counterexample to the main goal of their school could not be in a simpler geometric figure!

More recently, mathematics has received criticism because it provided some of the quantitative and modelling tools that contributed to the development of fake financial products, which, ultimately, led to the explosion of the world financial bubble. This is probably correct to some extent, but simultaneously when decision-makers are faced with this difficult economic scenario, and when the time to design new policies comes, they will have to make use of mathematics once more. Leonardo da Vinci once said: "There is no certainty where the mathematical method cannot be applied."

Applied mathematics is thus a tool for research in most fields of sciences, and an excellent remedy in this time of crisis. This is especially true for younger fellows who will find in this discipline a rich variety of challenging problems, requiring their talent and imagination.



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