



Interdisciplinary applications of mathematics

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Abstract

Mathematics is the study of space, quantity, change, and structure. Its history began with basic counting and is as old as humanity itself. No one can avoid mathematics, because it appears in everyday life—from cooking in the kitchen to exploring space on journeys to the Moon or Mars. Mathematics is present everywhere, even in nature. It forms the foundation of many disciplines, which makes it difficult to set clear boundaries for its uses. For example, mathematics plays a key role in economics, finance, banking, computer science, engineering, technology, biology, and social sciences. Daily human activities are closely connected to mathematics, and it serves as a powerful tool for solving problems with accuracy across different fields. In short, mathematics exists everywhere and is essential for both real-life situations and academic study

Keywords: mathematics, engineering, physics, biology, finance etc.

Introduction

Mathematics is the study of space, quality, change and structure. The mathematics of Babylonia developed from the 2000 BC. The mathematics word derived from the Greek word "mathema", that show the "subject of instruction". Mathematics history was started with the simple counting. Mathematics is the foundation for the development of many subjects. We are all surrounding a mathematical world. In real life the mathematical formulas, theories and concepts are widely used. The mathematical tools and techniques have importance and understanding its variety of applications. The mathematics plays a very crucial role in the field of economics also. The indispensable linkage has between mathematics and economics. The use of mathematics is growing day by day in different fields like Physics, biology, finance and banking, engineering, in real life etc. Some mathematics applications are discussed.

Branches of Mathematics

There are many branches of mathematics. Some the branches are

Arithmetic: The most basic branch, dealing with numbers and simple operations like addition, subtraction, multiplication, and division.

Algebra: Uses symbols and letters to represent numbers and relationships, helping to solve equations and problems.

Geometry: Focuses on shapes, sizes, angles, and the properties of space.

Trigonometry: Studies the relationships between angles and sides in triangles.

Calculus: Deals with change and motion, using concepts like derivatives and integrals.

Statistics: Involves collecting, analysing, and interpreting data.

Probability: Studies the chances of events happening.

Number Theory: Explores the properties and patterns of numbers, especially whole numbers.

Linear Algebra: Focuses on vectors, matrices, and systems of linear equations.

Discrete Mathematics: Studies structures that are separate or distinct, such as graphs, logic, and algorithms.

Applications of mathematics

Application of Mathematics in Industry Industrial:

Industrial mathematics, a vital branch of applied mathematics, focuses on addressing real-world problems that arise in industry and business. Its primary aim is to provide economical and efficient solutions by formulating precise mathematical models and applying advanced computational techniques. In today's increasingly complex business environment, mathematics serves as a powerful tool to guide managers, workers, and decision-makers toward better strategies and outcomes. The demand for mathematically trained professionals has grown significantly, as industries rely on quantitative methods to improve productivity, optimize resources, and enhance decision-making processes. Mathematical tools play a central role in solving design-related challenges, production planning, and operational efficiency. For example, linear programming enables businesses to tackle large-scale production and combination problems by identifying optimal solutions under given constraints. Thus, industrial mathematics not only strengthens the link between theory and practice but also demonstrates how mathematical knowledge directly contributes to innovation, competitiveness, and sustainable growth in modern industries.

Application of mathematics in computer Science:

Foundation mathematics is a unique discipline that provides the basis for many areas of science and engineering. Because of its wide-ranging applications, it is difficult to draw strict boundaries around its uses. In recent times, the connection between mathematics and computer science has become increasingly significant. Many mathematicians are working within computer science, while computer scientists themselves rely heavily on mathematical concepts in their research and practice. Although some argue that mathematics plays only a minor role in computer science, others maintain that mathematics is its very foundation.

Computer science can be viewed as a subset of mathematical science, with several branches of mathematics directly supporting its development. Topics such as graph theory, discrete mathematics, algebra, and binary mathematics are closely related to computer science and are essential for managing databases, designing algorithms, and structuring information systems. The knowledge of these mathematical concepts enables professionals to solve complex problems, optimize processes, and advance innovations in computing.

Application of Mathematics in Economics: Mathematics is applied in many fields, but it plays a particularly significant role in economics. Economists rely on mathematical tools such as geometry, calculus, and algebra to analyze data and draw meaningful conclusions. Mathematics serves as a universal language in economics, allowing researchers to achieve accurate results through formulas and models. The relationship between mathematics and economics is deeply interconnected, with advanced mathematical techniques often used to solve complex economic problems. For instance, trend analysis enables businesses to predict future outcomes, assess risks, and make informed decisions to minimize losses. Similarly, mathematical models help in understanding market behavior, optimizing resource allocation, and evaluating financial strategies. Thus, mathematics not only strengthens the theoretical foundation of economics but also provides practical solutions that guide businesses and policymakers in decision-making.

Application of Mathematics in Finance and Banking: In the modern era, the use of mathematics extends far beyond textbooks and classrooms, playing a crucial role in the fields of finance and banking. Mathematics is central to predicting fluctuations in the stock market and provides the foundation for financial mathematics, which is applied to solve complex finance-related problems. By using mathematical techniques, stockbrokers can analyze market trends and generate revenue, while banks and corporate institutions employ these methods for risk management, security valuation, and portfolio optimization. At the organizational level, senior officers rely on mathematical tools to formulate policies that guide institutions toward achieving their goals. These tools deliver immediate and accurate results, which would otherwise be difficult to obtain. Every financial decision, from daily transactions to long-term investments, is influenced by mathematics. A strong understanding of mathematical concepts is therefore essential in the finance and banking sector, ensuring effective planning, sound decision-making, and successful financial management.

Applications of Mathematics in Physics: Mathematics is an essential and powerful tool in physics, providing the language and framework for scientific calculations and theories. Physics cannot be studied or advanced without mathematics, as it supports the formulation and solution of complex problems. Techniques such as ordinary and partial differential equations, topology, infinite series, complex analysis, calculus, group theory, probability, and statistics are widely used in physics. Calculus, for example, is fundamental to equations of motion and is applied extensively across classical mechanics. In quantum mechanics, mathematics plays a central role in describing

physical quantities, which are expressed as probabilistic values. The wave function itself is inherently probabilistic in nature, highlighting the deep connection between mathematics and the physical sciences. Thus, mathematics not only supports but also drives the progress of physics, making it indispensable for understanding the universe.

Application of Mathematics in Biology: In modern times, mathematical biology has emerged as one of the most exciting applications of mathematics. A wide range of mathematical tools—such as graph theory, algebraic geometry, differential equations, probability theory, and coding theory—are now applied to biological research. Several biostatistics centers around the world focus on developing mathematical models that contribute to biology, including areas such as evolution and ecology. Complex biological processes, such as the functioning of tissues and cells, can often be successfully analyzed and explained through mathematical treatment, demonstrating the growing importance of mathematics in life sciences.

Application of Mathematics in Chemistry: Mathematics plays a fundamental role in chemistry by providing the tools needed to analyze, model, and predict chemical phenomena. Concepts such as algebra, calculus, probability, and statistics are widely used to understand chemical reactions, molecular structures, and thermodynamic processes. For example, calculus is applied in reaction rate equations and kinetics, while linear algebra supports quantum chemistry and spectroscopy. Probability and statistics are essential in analyzing experimental data and ensuring accuracy in laboratory results. Mathematical modeling also helps in predicting the behavior of complex chemical systems, designing new compounds, and optimizing industrial chemical processes. Thus, mathematics serves as the backbone of theoretical and applied chemistry, enabling chemists to move beyond observation and toward precise, quantitative understanding.

Application of Mathematics in Engineering: Mathematics forms the foundation of all engineering disciplines, providing the essential tools for analysis, design, and problem-solving. Engineering growth and innovation would not be possible without mathematical principles. Subjects such as statistics, numerical analysis, calculus, and linear algebra are taught as core components of engineering education because they are directly applied in practice. For example, calculus is used in modeling motion and energy systems, while linear algebra supports structural analysis and computer simulations. In mechanical engineering, mathematics serves as the backbone for designing machines and solving technical challenges. Similarly, electrical and civil engineering rely on mathematical models to ensure accuracy, efficiency, and safety in projects. Thus, mathematics is indispensable in engineering, enabling professionals to transform theoretical concepts into practical solutions that drive technological progress.

Conclusion

Mathematics is not only a subject of study but also a vital tool for solving real-life problems. Its theories, formulas, and techniques provide accuracy and efficiency in decision-making across diverse fields. From predicting trends to guiding investments, mathematical tools help individuals

and organizations plan for the future with confidence. In finance, economics, engineering, biology, and physics, mathematics enables precise analysis and policy formulation that would otherwise be difficult to achieve. A strong understanding of mathematical concepts ensures better problem-solving, risk management, and innovation, making mathematics indispensable for progress in both daily life and professional practice.

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