Algebra: A Very Short Introduction
Peter M. Higgins

Algebra marked the beginning of modern mathematics, moving it beyond arithmetic, which involves calculations featuring given numbers, to problems in which some quantities are unknown. Now, it stands as a pillar of mathematics, underpinning the quantitative sciences. Algebra: A Very Short Introduction explains algebra from scratch. Over the course of ten chapters, it offers a step by step approach for readers keen on developing their understanding of algebra. Using theory and example, it renews the reader’s acquaintance with school mathematics, before taking them progressively further and deeper into modern algebra, including groups, rings, fields, and vector spaces.

Applied Mathematics: A Very Short Introduction
Alain Goriely

Mathematics is playing an increasingly important role in society and the sciences, enhancing our ability to use models and handle data. Applied Mathematics: A Very Short Introduction introduces the field of applied mathematics and explores its relationships with pure mathematics, science, and engineering. Explaining the nature of applied mathematics, it discusses its early achievements in physics and engineering, and its development as a separate field after World War II. Using historical examples, current applications, and challenges, this VSI illustrates the particular role that mathematics plays in the modern sciences today and its far-reaching potential.

Big Data: A Very Short Introduction
Dawn E. Holmes

Big Data: A Very Short Introduction introduces the field of big data and explores its relationships with computer science, statistics, and related fields. Explaining the nature of big data, it discusses its early achievements in data science and its development as a separate field after the mid-1990s. Using historical examples, current applications, and challenges, this VSI illustrates the particular role that big data plays in the modern sciences today and its far-reaching potential.
Since long before computers were even thought of, data has been collected and organized by diverse cultures across the world. Once access to the Internet became a reality for large swathes of the world’s population, the amount of data generated each day became huge, and continues to grow exponentially. It includes all our uploaded documents, videos, and photos; all our social media traffic; our online shopping; even the GPS data from our cars. Big Data: A Very Short Introduction explains how big data works and is changing the world around us, the effect it has on our everyday lives and in the business world, and it considers the attendant security risks.

Combinatorics: A Very Short Introduction
Robin Wilson

Combinatorics is the branch of mathematics concerned with selecting, arranging, and listing or counting collections of objects. Dating back some 3000 years, and initially consisting mainly of the study of permutations and combinations, its scope has broadened to include topics such as graph theory, partitions of numbers, block designs, design of codes, and latin squares. Combinatorics: A Very Short Introduction provides an overview of the field and its applications in mathematics and computer theory, considering problems from the shortest routes covering certain stops to the minimum number of colours needed to draw a map with different colours for neighbouring countries.

Complexity: A Very Short Introduction
John H. Holland

From the movement of flocks of birds to the Internet, environmental sustainability, and market regulation, the study and understanding of complex non-linear systems has become highly influential over the last thirty years. Complexity: A Very Short Introduction introduces the key elements and conceptual framework of complexity. From complex physical systems such as fluid flow and the difficulties of predicting weather, to complex adaptive systems such as the highly diverse and interdependent ecosystems of rainforests, it combines simple, well-known examples—Adam Smith’s pin factory, Charles Darwin’s comet orchid, and Herbert Simon’s “watchmaker”—with an account of the approaches, involving agents and urn models, taken by complexity theory.

Cryptography: A Very Short Introduction
Fred Piper and Sean Murphy

Cryptography: A Very Short Introduction
Cryptography: A Very Short Introduction provides a clear and informative introduction to cryptography and data protection — subjects of considerable social and political importance. It explains what algorithms do, how they are used, the risks associated with using them, and why governments should be concerned. Important areas are highlighted, such as Stream Ciphers, block ciphers, public key algorithms, digital signatures, and applications such as e-commerce. This VSI highlights the explosive impact of cryptography on modern society, with, for example, the evolution of the internet and the introduction of more sophisticated banking methods.

Fractals: A Very Short Introduction
Kenneth Falconer

Fractals: A Very Short Introduction looks at the roots of the ‘fractal revolution’ that occurred in mathematics in the 20th century. It presents the ‘new geometry’ of fractals, explains the basic concepts, and explores the wide range of applications in science, and in aspects of economics. Many are familiar with the beauty and ubiquity of fractal forms within nature. Unlike the study of smooth forms, fractal geometry describes more familiar shapes and patterns, such as the complex contours of coastlines, the outlines of clouds, and the branching of trees. This is essential introductory reading for students of mathematics and science, and those interested in popular science and mathematics.

The History of Mathematics: A Very Short Introduction
Jacqueline Stedall

The History of Mathematics: A Very Short Introduction is arranged thematically to exemplify the varied contexts in which people have learned, used, and handed on mathematics. Using illustrative case studies drawn from a range of times and places, including early imperial China, the medieval Islamic world, and nineteenth-century Britain, the rich historical and cultural diversity of mathematical endeavour from the distant past to the present day is explored. Mathematics is a fundamental human activity that can be practised and understood in a multitude of ways; indeed, mathematical ideas themselves are far from being fixed; they have been adapted and changed by their passage across periods and cultures.
Infinity: A Very Short Introduction
Ian Stewart

Infinity has connections to philosophy, religion, and physics as well as mathematics. The infinitely large (infinite) is intimately related to the infinitely small (infinitesimal). Infinity: A Very Short Introduction explains the mathematical concept of infinity, its different forms, and its uses in calculus, Fourier analysis, and fractals, and also describes the philosophical aspects and debates involving infinity. It argues that working with infinity is not just an abstract, intellectual exercise, but that it is instead a concept with important practical everyday applications, and considers how mathematicians use infinity and infinitesimals to answer questions or supply techniques that do not appear to involve the infinite.

Mathematical Finance: A Very Short Introduction
Mark H. A. Davis

In recent years, the finance industry has mushroomed to become an important part of modern economies with many science and engineering graduates joining the industry as quantitative analysts, using mathematical and computational skills to solve complex problems of asset valuation and risk management. Mathematical Finance: A Very Short Introduction provides an overview of mathematical finance today. It introduces arbitrage theory, explaining why it works the way it does, and how it is key to pricing financial contracts, to credit trading, fund management, and the setting of interest rates. It also discusses developments to mathematical finance in the wake of the 2008 financial crash, and surveys the most pressing issues in mathematical finance today.

Mathematics: A Very Short Introduction
Timothy Gowers

The aim of Mathematics: A Very Short Introduction is to explain, carefully but not technically, the differences between advanced, research-level mathematics, and the sort of mathematics we learn at school. It offers readers an insight into such seemingly paradoxical concepts as infinity, imaginary numbers, and curved space. The first few chapters are concerned with general aspects of mathematical thought and are followed by chapters on more specific topics such as limits and infinity, dimension, geometry, and estimates and
approximations. It concludes with some answers to common sociological questions about the mathematical community.

Networks: A Very Short Introduction
Guido Caldarelli and Michele Catanzaro

Networks: A Very Short Introduction considers the basic elements of network theory and its applications using everyday examples from society, technology, nature, and history. It is impossible to understand the spread of an epidemic, a computer virus, large-scale blackouts, or massive extinctions without taking into account the network structure that underlies all these phenomena. The ubiquitous role of networks; how networks self-organize; why the rich get richer; and how networks can spontaneously collapse are all considered. The findings of complex network theory have very wide and important applications in genetics, ecology, communications, economics, and sociology.

Number Theory: A Very Short Introduction
Robin Wilson

Number Theory: A Very Short Introduction explains the branch of mathematics primarily concerned with the counting numbers, 1, 2, 3, …. Long considered one of the most ‘beautiful’ areas of mathematics, number theory dates back over two millennia to the Ancient Greeks, but has seen some startling new developments in recent years. Trailblazers in the field include mathematicians Euclid of Alexandria, Pierre de Fermat, Leonhard Euler, and Carl Friedrich Gauss. Number theory has intrigued and attracted amateurs and professionals alike for thousands of years, appearing in both recreational contexts (puzzles) and practical concerns (cryptography). Some problems in number theory are easy, whereas others are notorious with no known solutions to date.

Numbers: A Very Short Introduction
Peter M. Higgins

Numbers: A very Short Introduction unravels the world of numbers; demonstrating its richness, and providing a comprehensive view of the idea of the number. This VSI paints a picture of the number world, considering how the modern number system matured over centuries. Explaining the various number types and showing how they behave, it
introduces key concepts such as integers, fractions, real numbers, and imaginary numbers. By approaching the topic in a non-technical way and emphasising the basic principles and interactions of numbers with mathematics and science, this VSI also demonstrates practical interactions and modern applications, such as encryption of confidential data on the internet.

Probability: A Very Short Introduction
John Haigh

Probability: A Very Short Introduction explores ideas of probability and the different philosophical approaches to it. It provides a brief account of the history of development of probability theory, and considers the work of some of the big players: from Galileo and Pascal to Bayes, Laplace, Poisson, and Markov. Making good decisions under conditions of uncertainty — which is the norm — requires a sound appreciation of the way random chance works. As analysis and modelling of most aspects of the world, and all measurement, are necessarily imprecise and involve uncertainties of varying degrees, the understanding and management of probabilities is central to much work in the sciences and economics.

Statistics: A Very Short Introduction
David J. Hand

Statistics: A Very Short Introduction describes a field very different from the dry and dusty discipline of the popular imagination. In its place is an exciting subject which uses deep theory and powerful software tools to shed light and enable understanding. And it sheds this light on all aspects of our lives, enabling astronomers to explore the origins of the universe, archaeologists to investigate ancient civilisations, governments to understand how to benefit and improve society, and businesses to learn how best to provide goods and services. Aimed at readers with no prior mathematical knowledge, this Very Short Introduction explores and explains how statistics work, and how we can decipher them.

Symmetry: A Very Short Introduction
Ian Stewart

Symmetry: A Very Short Introduction provides an introduction to the formal theory of symmetry: group theory. Now a branch of abstract algebra, this subject first arose in the
theory of equations. Symmetry is an immensely important concept in mathematics and throughout the sciences, and its applications range across the entire subject. Symmetry governs the structure of crystals, innumerable types of pattern formation, how systems change their state as parameters vary; and fundamental physics is governed by symmetries in the laws of nature. It is highly visual, with applications that include animal markings, locomotion, evolutionary biology, elastic buckling, waves, the shape of the Earth, and the form of galaxies.

Topology: A Very Short Introduction
Richard Earl

Topology, the mathematical study of the properties that are preserved through the deformations, twistings, and stretchings of objects, is an important area of modern mathematics. Topology: A Very Short Introduction provides a sense of the more visual elements of topology (looking at surfaces) as well as covering the formal definition of continuity. Considering some of the eye-opening examples that led mathematicians to recognize a need for studying topology, it pays homage to the historical people, problems, and surprises that have propelled the growth of this field. As broad and fundamental as algebra and geometry, its study has important implications for science more generally, especially physics.

Trigonometry: A Very Short Introduction
Glen Van Brummelen

Trigonometry: A Very Short Introduction draws together the full history of trigonometry, stretching across two millennia and several cultures such as ancient Greece, medieval India, and the Islamic world. It introduces the key concepts of trigonometry, drawing readers beyond the basic relationships first encountered in school to reveal the richness of the entire subject of trigonometry and ideas such as curved space. It also explores connections with genuine modern applications, including navigation, the analysis of music, computer graphics, and powerful modelling tools in science, and shows how trigonometry has participated in big questions about the world, including the shape of the universe and the nature of infinity.