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Pentagons and Pentagrams
An Illustrated History
Eli Maor, Eugen Jost

A fascinating exploration of the pentagon and its role in various cultures

The pentagon and its close cousin, the pentagram, have inspired individuals for the last two and half millennia, from mathematicians and philosophers to artists and naturalists. Despite the pentagon’s wide-ranging history, no single book has explored the important role of this shape in various cultures, until now. Richly illustrated, Pentagons and Pentagrams offers a sweeping view of the five-sided polygon, revealing its intriguing geometric properties and its essential influence on a variety of fields.

Traversing time, Eli Maor narrates vivid stories, both celebrated and unknown, about the pentagon and pentagram. He discusses the early Pythagoreans, who ascribed to the pentagon mythical attributes, adopted it as their emblem, and figured out its construction with a straightedge and compass. Maor looks at how a San Diego housewife uncovered four previously unknown types of pentagonal tilings, and how in 1982 a scientist’s discovery of fivefold symmetries in certain alloys caused an uproar in crystallography and led to a Nobel Prize. Maor also discusses the pentagon’s impact on many buildings, from medieval fortresses to the Pentagon in Washington, D.C. Eugen Jost’s superb illustrations provide sumptuous visual context, and the book’s puzzles and mazes offer fun challenges for readers, with solutions given in an appendix.

Partial Truths
How Fractions Distort Our Thinking
James C. Zimring

A fast-food chain once tried to compete with McDonald’s quarter-pounder by introducing a third-pound hamburger—only for it to flop when consumers thought a third pound was less than a quarter pound because three is less than four. Separately, a rash of suicides by teenagers who played Dungeons and Dragons caused a panic in parents and the media. They thought D&D was causing teenage suicides—when in fact teenage D&D players died by suicide at a much lower rate than the national average. Errors of this type can be found from antiquity to the present, from the Peloponnesian War to the COVID-19 pandemic. How and why do we keep falling into these traps?

James C. Zimring argues that many of the mistakes that the human mind consistently makes boil down to misperceiving fractions. We see slews of statistics that are essentially fractions, such as percentages, probabilities, frequencies, and rates, and we tend to misinterpret them. Sometimes bad actors manipulate us by cherry-picking data or distorting how information is presented; other times, sloppy communicators inadvertently mislead us. In many cases, we fool ourselves and have only our own minds to blame. Zimring also explores the counterintuitive reason that these flaws might benefit us, demonstrating that individual error can be highly advantageous to problem solving by groups. Blending key scientific research in cognitive psychology with accessible real-life examples, Partial Truths helps readers spot the fallacies lurking in everyday information, from politics to the criminal justice system, from religion to science, from business strategies to New Age culture.
Behind Deep Blue
Building the Computer That Defeated the World Chess Champion
Feng–hsiung Hsu, Jon Kleinberg

The riveting quest to construct the machine that would take on the world’s greatest human chess player—told by the man who built it

On May 11, 1997, millions worldwide heard news of a stunning victory, as a machine defeated the defending world chess champion, Garry Kasparov. Behind Deep Blue tells the inside story of the quest to create the mother of all chess machines and what happened at the two historic Deep Blue vs. Kasparov matches. Feng–hsiung Hsu, the system architect of Deep Blue, reveals how a modest student project started at Carnegie Mellon in 1985 led to the production of a multimillion-dollar supercomputer. Hsu discusses the setbacks, tensions, and rivalries in the race to develop the ultimate chess machine, and the wild controversies that culminated in the final triumph over the world’s greatest human player. With a new foreword by Jon Kleinberg and a new preface from the author, Behind Deep Blue offers a remarkable look at one of the most famous advances in artificial intelligence, and the brilliant toolmaker who invented it.

The Discrete Charm of the Machine
Why the World Became Digital
Ken Steiglitz

The genesis of the digital idea and why it transformed civilization

A few short decades ago, we were informed by the smooth signals of analog television and radio; we communicated using our analog telephones; and we even computed with analog computers. Today our world is digital, built with zeros and ones. Why did this revolution occur? The Discrete Charm of the Machine explains, in an engaging and accessible manner, the varied physical and logical reasons behind this radical transformation.

The spark of individual genius shines through this story of innovation: the stored program of Jacquard’s loom; Charles Babbage’s logical branching; Alan Turing’s brilliant abstraction of the discrete machine; Harry Nyquist’s foundation for digital signal processing; Claude Shannon’s breakthrough insights into the meaning of information and bandwidth; and Richard Feynman’s prescient proposals for nanotechnology and quantum computing. Ken Steiglitz follows the progression of these ideas in the building of our digital world, from the internet and artificial intelligence to the edge of the unknown. Are questions like the famous traveling salesman problem truly beyond the reach of ordinary digital computers? Can quantum computers transcend these barriers? Does a mysterious magical power reside in the analog mechanisms of the brain? Steiglitz concludes by confronting the moral and aesthetic questions raised by the development of artificial intelligence and autonomous robots.

The Discrete Charm of the Machine examines why our information technology, the lifeblood of our civilization, became digital, and challenges us to think about where its future trajectory may lead.
The Essence of Software  
Why Concepts Matter for Great Design  
Daniel Jackson  

A revolutionary concept-based approach to thinking about, designing, and interacting with software

As our dependence on technology increases, the design of software matters more than ever before. Why then is so much software flawed? Why hasn’t there been a systematic and scalable way to create software that is easy to use, robust, and secure?

Examining these issues in depth, The Essence of Software introduces a theory of software design that gives new answers to old questions. Daniel Jackson explains that a software system should be viewed as a collection of interacting concepts, breaking the functionality into manageable parts and providing a new framework for thinking about design. Through this radical and original perspective, Jackson lays out a practical and coherent path, accessible to anyone—from strategist and marketer to UX designer, architect, or programmer—for making software that is empowering, dependable, and a delight to use.

Jackson explores every aspect of concepts—what they are and aren’t, how to identify them, how to define them, and more—and offers prescriptive principles and practical tips that can be applied cost-effectively in a wide range of domains. He applies these ideas to contemporary software designs, drawing examples from leading software manufacturers such as Adobe, Apple, Dropbox, Facebook, Google, Microsoft, Twitter, and others. Jackson shows how concepts let designers preserve and reuse design knowledge, rather than starting from scratch in every project.

An argument against the status quo and a guide to improvement for both working designers and novices to the field, The Essence of Software brings a fresh approach to software and its creation.

Better Data Visualizations  
A Guide for Scholars, Researchers, and Wonks  
Jonathan Schwabish  

Now more than ever, content must be visual if it is to travel far. Readers everywhere are overwhelmed with a flow of data, news, and text. Visuals can cut through the noise and make it easier for readers to recognize and recall information. Yet many researchers were never taught how to present their work visually.

This book details essential strategies to create more effective data visualizations. Jonathan Schwabish walks readers through the steps of creating better graphs and how to move beyond simple line, bar, and pie charts. Through more than five hundred examples, he demonstrates the do’s and don’ts of data visualization, the principles of visual perception, and how to make subjective style decisions around a chart’s design. Schwabish surveys more than eighty visualization types, from histograms to horizon charts, ridgeline plots to choropleth maps, and explains how each has its place in the visual toolkit. It might seem intimidating, but everyone can learn how to create compelling, effective data visualizations. This book will guide you as you define your audience and goals, choose the graph that best fits your data, and clearly communicate your message.
Dark Data
Why What You Don’t Know Matters
David J. Hand

In the era of big data, it is easy to imagine that we have all the information we need to make good decisions. But in fact the data we have are never complete, and may be only the tip of the iceberg. Just as much of the universe is composed of dark matter, invisible to us but nonetheless present, the universe of information is full of dark data that we overlook at our peril. In Dark Data, data expert David Hand takes us on a fascinating and enlightening journey into the world of the data we don’t see.

Dark Data explores the many ways in which we can be blind to missing data and how that can lead us to conclusions and actions that are mistaken, dangerous, or even disastrous. Examining a wealth of real-life examples, from the Challenger shuttle explosion to complex financial frauds, Hand gives us a practical taxonomy of the types of dark data that exist and the situations in which they can arise, so that we can learn to recognize and control for them. In doing so, he teaches us not only to be alert to the problems presented by the things we don’t know, but also shows how dark data can be used to our advantage, leading to greater understanding and better decisions.

Today, we all make decisions using data. Dark Data shows us all how to reduce the risk of making bad ones.

Mathletics
Wayne L. Winston, Scott Nestler, Konstantinos Pelechrinis

How to use math to improve performance and predict outcomes in professional sports

Mathletics reveals the mathematical methods top coaches and managers use to evaluate players and improve team performance, and gives math enthusiasts the practical skills they need to enhance their understanding and enjoyment of their favorite sports—and maybe even gain the outside edge to winning bets. This second edition features new data, new players and teams, and new chapters on soccer, e-sports, golf, volleyball, gambling Calcuttas, analysis of camera data, Bayesian inference, ridge regression, and other statistical techniques. After reading Mathletics, you will understand why baseball teams should almost never bunt; why football overtime systems are unfair; why points, rebounds, and assists aren’t enough to determine who’s the NBA’s best player; and more.
**Bernoulli's Fallacy**

**Statistical Illogic and the Crisis of Modern Science**

**Aubrey Clayton**

There is a logical flaw in the statistical methods used across experimental science. This fault is not a minor academic quibble: it underlies a reproducibility crisis now threatening entire disciplines. In an increasingly statistics-reliant society, this same deeply rooted error shapes decisions in medicine, law, and public policy with profound consequences. The foundation of the problem is a misunderstanding of probability and its role in making inferences from observations.

Aubrey Clayton traces the history of how statistics went astray, beginning with the groundbreaking work of the seventeenth-century mathematician Jacob Bernoulli and winding through gambling, astronomy, and genetics. Clayton recounts the feuds among rival schools of statistics, exploring the surprisingly human problems that gave rise to the discipline and the all-too-human shortcomings that derailed it. He highlights how influential nineteenth- and twentieth-century figures developed a statistical methodology they claimed was purely objective in order to silence critics of their political agendas, including eugenics.

Clayton provides a clear account of the mathematics and logic of probability, conveying complex concepts accessibly for readers interested in the statistical methods that frame our understanding of the world. He contends that we need to take a Bayesian approach—that is, to incorporate prior knowledge when reasoning with incomplete information—in order to resolve the crisis. Ranging across math, philosophy, and culture, *Bernoulli's Fallacy* explains why something has gone wrong with how we use data—and how to fix it.

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**In Pursuit of Zeta-3**

**The World's Most Mysterious Unsolved Math Problem**

**Paul J. Nahin**

An engrossing look at the history and importance of a centuries-old but still unanswered math problem

For centuries, mathematicians the world over have tried, and failed, to solve the zeta-3 problem. Math genius Leonhard Euler attempted it in the 1700s and came up short. The straightforward puzzle considers if there exists a simple symbolic formula for the following: $1+(1/2)^3+(1/3)^3+(1/4)^3+\ldots$. But why is this issue—the sum of the reciprocals of the positive integers cubed—so important? With *In Pursuit of Zeta-3*, popular math writer Paul Nahin investigates the history and significance of this mathematical conundrum.

Drawing on detailed examples, historical anecdotes, and even occasionally poetry, Nahin sheds light on the richness of the nature of zeta-3. He shows its intimate connections to the Riemann hypothesis, another mathematical mystery that has stumped mathematicians for nearly two centuries. He looks at its links with Euler’s achievements and explores the modern research area of Euler sums, where zeta-3 occurs frequently. An exact solution to the zeta-3 question wouldn’t simply satisfy pure mathematical interest: it would have critical ramifications for applications in physics and engineering, such as quantum electrodynamics.

Challenge problems with detailed solutions and MATLAB code are included at the end of each of the book’s sections.

Detailing the trials and tribulations of mathematicians who have approached one of the field’s great unsolved riddles, *In Pursuit of Zeta-3* will tantalize curious math enthusiasts everywhere.

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**Bernoulli’s Fallacy**

**In Pursuit of Zeta-3**
Music, Math, and Mind
The Physics and Neuroscience of Music
David Sulzer

Why does a clarinet play at lower pitches than a flute? What does it mean for sounds to be in or out of tune? How are emotions carried by music? Do other animals perceive sound like we do? How might a musician use math to come up with new ideas?

This book offers a lively exploration of the mathematics, physics, and neuroscience that underlie music in a way that readers without scientific background can follow. David Sulzer, also known in the musical world as Dave Soldier, explains why the perception of music encompasses the physics of sound, the functions of the ear and deep-brain auditory pathways, and the physiology of emotion. He delves into topics such as the math by which musical scales, rhythms, tuning, and harmonies are derived, from the days of Pythagoras to technological manipulation of sound waves. Sulzer ranges from styles from around the world to canonical composers to hip-hop, the history of experimental music, and animal sound by songbirds, cetaceans, bats, and insects. He makes accessible a vast range of material, helping readers discover the universal principles behind the music they find meaningful.

Written for musicians and music lovers with any level of science and math proficiency, including none, Music, Math, and Mind demystifies how music works while testifying to its beauty and wonder.

Do Not Erase
Mathematicians and Their Chalkboards
Jessica Wynne

A photographic exploration of mathematicians' chalkboards

“A mathematician, like a painter or poet, is a maker of patterns,” wrote the British mathematician G. H. Hardy. In Do Not Erase, photographer Jessica Wynne presents remarkable examples of this idea through images of mathematicians’ chalkboards. While other fields have replaced chalkboards with whiteboards and digital presentations, mathematicians remain loyal to chalk for puzzling out their ideas and communicating their research. Wynne offers more than one hundred stunning photographs of these chalkboards, gathered from a diverse group of mathematicians around the world. The photographs are accompanied by essays from each mathematician, reflecting on their work and processes. Together, pictures and words provide an illuminating meditation on the unique relationships among mathematics, art, and creativity.

The mathematicians featured in this collection comprise exciting new voices alongside established figures, including Sun-Yung Alice Chang, Alain Connes, Misha Gromov, Andre Neves, Kasso Okoudjou, Peter Shor, Christina Sormani, Terence Tao, Claire Voisin, and many others. The companion essays give insights into how the chalkboard serves as a special medium for mathematical expression. The volume also includes an introduction by the author, an afterword by New Yorker writer Alec Wilkinson, and biographical information for each contributor.

Do Not Erase is a testament to the myriad ways that mathematicians use their chalkboards to reveal the conceptual and visual beauty of their discipline—shapes, figures, formulas, and conjectures created through imagination, argument, and speculation.
How to Fall Slower Than Gravity
And Other Everyday (and Not So Everyday) Uses of Mathematics and Physical Reasoning
Paul J. Nahin

An engaging collection of intriguing problems that shows you how to think like a mathematical physicist

Paul Nahin is a master at explaining odd phenomena through straightforward mathematics. In this collection of twenty-six intriguing problems, he explores how mathematical physicists think. Always entertaining, the problems range from ancient catapult contrivances to the puzzling physics of a very peculiar material called NASTYGLASS—and from dodging trucks to why raindrops fall slower than the rate of gravity. The questions raised may seem impossible to answer at first and may require an unexpected twist in reasoning, but sometimes their solutions are surprisingly simple. Nahin's goal, however, is always to guide readers—who will need only to have studied advanced high school math and physics—in expanding their mathematical thinking to make sense of the curiosities of the physical world.

The problems are in the first part of the book and the solutions are in the second, so that readers may challenge themselves to solve the questions on their own before looking at the explanations. The problems show how mathematics—including algebra, trigonometry, geometry, and calculus—can be united with physical laws to solve both real and theoretical problems. Historical anecdotes woven throughout the book bring alive the circumstances and people involved in some amazing discoveries and achievements.

More than a puzzle book, this work will immerse you in the delights of scientific history while honing your math skills.

Tales of Impossibility
The 2000-Year Quest to Solve the Mathematical Problems of Antiquity
David S. Richeson

A comprehensive look at four of the most famous problems in mathematics

Tales of Impossibility recounts the intriguing story of the renowned problems of antiquity, four of the most famous and studied questions in the history of mathematics. First posed by the ancient Greeks, these compass and straightedge problems—squaring the circle, trisecting an angle, doubling the cube, and inscribing regular polygons in a circle—have served as ever-present muses for mathematicians for more than two millennia. David Richeson follows the trail of these problems to show that ultimately their proofs—which demonstrated the impossibility of solving them using only a compass and straightedge—depended on and resulted in the growth of mathematics.

Richeson investigates how celebrated luminaries, including Euclid, Archimedes, Viète, Descartes, Newton, and Gauss, labored to understand these problems and how many major mathematical discoveries were related to their explorations. Although the problems were based in geometry, their resolutions were not, and had to wait until the nineteenth century, when mathematicians had developed the theory of real and complex numbers, analytic geometry, algebra, and calculus. Pierre Wantzel, a little-known mathematician, and Ferdinand von Lindemann, through his work on pi, finally determined the problems were impossible to solve. Along the way, Richeson provides entertaining anecdotes connected to the problems, such as how the Indiana state legislature passed a bill setting an incorrect value for pi and how Leonardo da Vinci made elegant contributions in his own study of these problems.

Taking readers from the classical period to the present, Tales of Impossibility chronicles how four unsolvable problems have captivated mathematical thinking for centuries.

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Paperback
320 pages | 133mm : 208mm
2022
Mathematics / Recreations & Games
Princeton University Press

9780691218724
$22.95 | £17.99
Paperback
456 pages | 133.35mm : 203.2mm
2022
Mathematics / History & Philosophy
Princeton University Press
Curves for the Mathematically Curious
An Anthology of the Unpredictable, Historical, Beautiful, and Romantic
Julian Havil

Ten amazing curves personally selected by one of today's most important math writers

Curves for the Mathematically Curious is a thoughtfully curated collection of ten mathematical curves, selected by Julian Havil for their significance, mathematical interest, and beauty. Each chapter gives an account of the history and definition of one curve, providing a glimpse into the elegant and often surprising mathematics involved in its creation and evolution. In telling the ten stories, Havil introduces many mathematicians and other innovators, some whose fame has withstood the passing of years and others who have slipped into comparative obscurity. You will meet Pierre Bézier, who is known for his ubiquitous and eponymous curves, and Adolphe Quetelet, who trumpeted the ubiquity of the normal curve but whose name now hides behind the modern body mass index. These and other ingenious thinkers engaged with the challenges, incongruities, and insights to be found in these remarkable curves—and now you can share in this adventure.

Curves for the Mathematically Curious is a rigorous and enriching mathematical experience for anyone interested in curves, and the book is designed so that readers who choose can follow the details with pencil and paper. Every curve has a story worth telling.

99 Variations on a Proof
Philip Ording

An exploration of mathematical style through 99 different proofs of the same theorem

This book offers a multifaceted perspective on mathematics by demonstrating 99 different proofs of the same theorem. Each chapter solves an otherwise unremarkable equation in distinct historical, formal, and imaginative styles that range from Medieval, Topological, and Doggerel to Chromatic, Electrostatic, and Psychodelic. With a rare blend of humor and scholarly aplomb, Philip Ording weaves these variations into an accessible and wide-ranging narrative on the nature and practice of mathematics.

Inspired by the experiments of the Paris-based writing group known as the Oulipo—whose members included Raymond Queneau, Italo Calvino, and Marcel Duchamp—Ording explores new ways to examine the aesthetic possibilities of mathematical activity. 99 Variations on a Proof is a mathematical take on Queneau's Exercises in Style, a collection of 99 retellings of the same story, and it draws unexpected connections to everything from mysticism and technology to architecture and sign language. Through diagrams, found material, and other imagery, Ording illustrates the flexibility and creative potential of mathematics despite its reputation for precision and rigor.

Readers will gain not only a bird's-eye view of the discipline and its major branches but also new insights into its historical, philosophical, and cultural nuances. Readers, no matter their level of expertise, will discover in these proofs and accompanying commentary surprising new aspects of the mathematical landscape.
The Best Writing on Mathematics 2021
Mircea Pitici

The year’s finest mathematical writing from around the world

This annual anthology brings together the year’s finest mathematics writing from around the world—and you don’t need to be a mathematician to enjoy the pieces collected here. These essays—from leading names and fresh new voices—delve into the history, philosophy, teaching, and everyday aspects of math, offering surprising insights into its nature, meaning, and practice, and taking readers behind the scenes of today’s hottest mathematical debates.

Here, Viktor Blåsjö gives a brief history of “lockdown mathematics”; Yelda Nasifoglu decodes the politics of a seventeenth-century play in which the characters are geometric shapes; and Andrew Lewis-Pye explains the basic algorithmic rules and computational procedures behind cryptocurrencies. In other essays, Terence Tao candidly recalls the adventures and misadventures of growing up to become a leading mathematician; Natalie Wolchover shows how old math gives new clues about whether time really flows; and David Hand discusses the problem of “dark data”—information that is missing or ignored. And there is much, much more.

The Best Writing on Mathematics 2020
Mircea Pitici

The year’s finest mathematical writing from around the world

This annual anthology brings together the year’s finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2020 makes available to a wide audience many articles not easily found anywhere else—and you don’t need to be a mathematician to enjoy them. These writings offer surprising insights into the nature, meaning, and practice of mathematics today. They delve into the history, philosophy, teaching, and everyday aspects of math, and take readers behind the scenes of today’s hottest mathematical debates.

Here, Steven Strogatz reveals how calculus drives advances in virology, Paul Thagard argues that the power of mathematics stems from its combination of realistic and fictional qualities, and Erica Klarreich describes how Hao Huang used the combinatorics of cube nodes to solve a longstanding problem in computer science. In other essays, John Baez tells how he discovered the irresistible attractions of algebraic geometry, Mark Colyvan compares the radically different explanatory practices of mathematics and science, and Boris Odehnal reviews some surprising properties of multidimensional geometries. And there’s much, much more.

In addition to presenting the year’s most memorable writings on mathematics, this must-have anthology includes a bibliography of other notable writings and an introduction by the editor.

This book belongs on the shelf of anyone interested in where math has taken us—and where it is headed.
The Best Writing on Mathematics 2019
Mircea Pitici

The year's finest mathematical writing from around the world

This annual anthology brings together the year's finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2019 makes available to a wide audience many articles not easily found anywhere else—and you don't need to be a mathematician to enjoy them. These essays delve into the history, philosophy, teaching, and everyday aspects of math, offering surprising insights into its nature, meaning, and practice—and taking readers behind the scenes of today's hottest mathematical debates.

In this volume, Moon Duchin explains how geometric-statistical methods can be used to combat gerrymandering, Jeremy Avigad illustrates the growing use of computation in making and verifying mathematical hypotheses, and Kokichi Sugihara describes how to construct geometrical objects with unusual visual properties. In other essays, Neil Sloane presents some recent additions to the vast database of integer sequences he has catalogued, and Alessandro Di Bucchianico and his colleagues highlight how mathematical methods have been successfully applied to big-data problems. And there's much, much more.

In addition to presenting the year's most memorable math writing, this must-have anthology includes an introduction by the editor and a bibliography of other notable writings on mathematics.

This is a must-read for anyone interested in where math has taken us—and where it is headed.

The Best Writing on Mathematics 2018
Mircea Pitici

The year's finest mathematical writing from around the world

This annual anthology brings together the year's finest mathematics writing from around the world. Featuring promising new voices alongside some of the foremost names in the field, The Best Writing on Mathematics 2018 makes available to a wide audience many pieces not easily found anywhere else—and you don't need to be a mathematician to enjoy them. These essays delve into the history, philosophy, teaching, and everyday aspects of math, offering surprising insights into its nature, meaning, and practice—and taking readers behind the scenes of today's hottest mathematical debates.

James Grime shows how to build subtly mischievous dice for playing slightly unfair games and Michael Barany traces how our appreciation of the societal importance of mathematics has developed since World War II. In other essays, Francis Su extolls the inherent values of learning, doing, and sharing mathematics, and Margaret Wertheim takes us on a mathematical exploration of the mind and the world—with glimpses at science, philosophy, music, art, and even crocheting. And there's much, much more.

In addition to presenting the year's most memorable math writing, this must-have anthology includes an introduction by the editor and a bibliography of other notable pieces on mathematics.

This is a must-read for anyone interested in where math has taken us—and where it is headed.
The interest earned on a bank account, the arrangement of seeds in a sunflower, and the shape of the Gateway Arch in St. Louis are all intimately connected with the mysterious number $e$. In this informal and engaging history, Eli Maor portrays the curious characters and the elegant mathematics that lie behind the number. Designed for a reader with only a modest mathematical background, this biography brings out the central importance of $e$ to mathematics and illuminates a golden era in the age of science.

**The Pythagorean Theorem**

*A 4,000-Year History*

**Eli Maor**

9780691136886

$17.95 : £14.99

Paperback

296 pages | 139.7mm : 215.9mm

2019

Mathematics

Princeton Science Library

Princeton University Press

An exploration of one of the most celebrated and well-known theorems in mathematics

By any measure, the Pythagorean theorem is the most famous statement in all of mathematics. In this book, Eli Maor reveals the full story of this ubiquitous geometric theorem. Although attributed to Pythagoras, the theorem was known to the Babylonians more than a thousand years earlier. Pythagoras may have been the first to prove it, but his proof—if indeed he had one—is lost to us. The theorem itself, however, is central to almost every branch of science, pure or applied. Maor brings to life many of the characters that played a role in its history, providing a fascinating backdrop to perhaps our oldest enduring mathematical legacy.

**Music by the Numbers**

*From Pythagoras to Schoenberg*

**Eli Maor**

978069112969

$17.95 : £14.99

Paperback

176 pages | 139.7mm : 215.9mm

2020

Mathematics

Princeton University Press

How music has influenced mathematics, physics, and astronomy from ancient Greece to the twentieth century

Music is filled with mathematical elements. The works of Bach are often said to possess a math-like logic, and Arnold Schoenberg, Iannis Xenakis, and Karlheinz Stockhausen wrote music explicitly based on mathematical principles. Yet Eli Maor argues that it is music that has had the greater influence on mathematics, not the other way around. Starting with Pythagoras, proceeding through Schoenberg, and bringing the story up to the present with contemporary string theory, *Music by the Numbers* tells a fascinating story of composers, scientists, inventors, and eccentrics who have played a role in the age-old relationship between music, mathematics, and the physical sciences. Weaving compelling stories of historical episodes with Maor's personal reflections as a mathematician and lover of classical music, this book will delight anyone who loves math and music.

**Trigonometric Delights**

**Eli Maor**

9780691202198

$17.95 : £14.99

Paperback

256 pages | 139.7mm : 215.9mm

2020

Mathematics

Princeton Science Library

Princeton University Press

A fun, entertaining exploration of the ideas and people behind the growth of trigonometry

Trigonometry has a reputation as a dry, difficult branch of mathematics, a glorified form of geometry complicated by tedious computation. In *Trigonometric Delights*, Eli Maor dispels this view. Rejecting the usual descriptions of sine, cosine, and their trigonometric relatives, he brings the subject to life in a compelling blend of history, biography, and mathematics. From the proto-trigonometry of the Egyptian pyramid builders and the first true trigonometry developed by Greek astronomers, to the epicycles and hypocycles of the toy Spirograph, Maor presents both a survey of the main elements of trigonometry and a unique account of its vital contribution to science and social growth. A tapestry of stories, curiosities, insights, and illustrations, *Trigonometric Delights* irrevocably changes how we see this essential mathematical discipline.
We all played tag when we were kids. What most of us don’t realize is that this simple chase game is in fact an application of pursuit theory, and that the same principles of games like tag, dodgeball, and hide-and-seek are also at play in military strategy, high-seas chases by the Coast Guard, and even romantic pursuits. In Chases and Escapes, Paul Nahin gives us the first complete history of this fascinating area of mathematics, from its classical analytical beginnings to the present day.

Drawing on game theory, geometry, linear algebra, target-tracking algorithms, and much more, Nahin also offers an array of challenging puzzles with their historical background and broader applications. Chases and Escapes includes solutions to all problems and provides computer programs that readers can use for their own cutting-edge analysis.

Now with a gripping new preface on how the Enola Gay escaped the shock wave from the atomic bomb dropped on Hiroshima, this book will appeal to anyone interested in the mathematics that underlie pursuit and evasion.
Slicing Pizzas, Racing Turtles, and Further Adventures in Applied Mathematics
Robert B. Banks

Have you ever daydreamed about digging a hole to the other side of the world? Robert Banks not only entertains such ideas but, better yet, he supplies the mathematical know-how to turn fantasies into problem-solving adventures. In this sequel to the popular Towing Icebergs, Falling Dominoes (Princeton, 1998), Banks presents another collection of puzzles for readers interested in sharpening their thinking and mathematical skills. The problems range from the wondrous to the eminently practical. In one chapter, the author helps us determine the total number of people who have lived on earth; in another, he shows how an understanding of mathematical curves can help a thrifty lover, armed with construction paper and scissors, keep expenses down on Valentine's Day.

In twenty-six chapters, Banks chooses topics that are fairly easy to analyze using relatively simple mathematics. The phenomena he describes are ones that we encounter in our daily lives or can visualize without much trouble. For example, how do you get the most pizza slices with the least number of cuts? To go from point A to point B in a downpour of rain, should you walk slowly, jog moderately, or run as fast as possible to get least wet? What is the length of the seam on a baseball? If all the ice in the world melted, what would happen to Florida, the Mississippi River, and Niagara Falls? Why do snowflakes have six sides?

Covering a broad range of fields, from geography and environmental studies to map- and flag-making, Banks uses basic algebra and geometry to solve problems. If famous scientists have also pondered these questions, the author shares the historical details with the reader. Designed to entertain and to stimulate thinking, this book can be read for sheer personal enjoyment.

Towing Icebergs, Falling Dominoes, and Other Adventures in Applied Mathematics
Robert B. Banks

Although we seldom think of it, our lives are played out in a world of numbers. Such common activities as throwing baseballs, skipping rope, growing flowers, playing football, measuring savings accounts, and many others are inherently mathematical. So are more speculative problems that are simply fun to ponder in themselves—such as the best way to score Olympic events.

Here Robert Banks presents a wide range of musings, both practical and entertaining, that have intrigued him and others: How tall can one grow? Why do we get stuck in traffic? Which football player would have a better chance of breaking away—a small, speedy wide receiver or a huge, slow linebacker? Can California water shortages be alleviated by towing icebergs from Antarctica? What is the fastest the 100-meter dash will ever be run?

The book's twenty-four concise chapters, each centered on a real-world phenomenon, are presented in an informal and engaging manner. Banks shows how math and simple reasoning together may produce elegant models that explain everything from the federal debt to the proper technique for ski-jumping.

This book, which requires of its readers only a basic understanding of high school or college math, is for anyone fascinated by the workings of mathematics in our everyday lives, as well as its applications to what may be imagined. All will be rewarded with a myriad of interesting problems and the know-how to solve them.
Duelling Idiots and Other Probability Puzzlers
Paul J. Nahin

What are your chances of dying on your next flight, being called for jury duty, or winning the lottery? We all encounter probability problems in our everyday lives. In this collection of twenty-one puzzles, Paul Nahin challenges us to think creatively about the laws of probability as they apply in playful, sometimes deceptive, ways to a fascinating array of speculative situations. Games of Russian roulette, problems involving the accumulation of insects on flypaper, and strategies for determining the odds of the underdog winning the World Series all reveal intriguing dimensions to the workings of probability. Over the years, Nahin, a veteran writer and teacher of the subject, has collected these and other favorite puzzles designed to instruct and entertain math enthusiasts of all backgrounds.

If idiots A and B alternately take aim at each other with a six-shot revolver containing one bullet, what is the probability idiot A will win? What are the chances it will snow on your birthday in any given year? How can researchers use coin flipping and the laws of probability to obtain honest answers to embarrassing survey questions? The solutions are presented here in detail, and many contain a profound element of surprise. And some puzzles are beautiful illustrations of basic mathematical concepts: "The Blind Spider and the Fly," for example, is a clever variation of a "random walk" problem, and "Duelling Idiots" and "The Underdog and the World Series" are straightforward introductions to binomial distributions.

Written in an informal way and containing a plethora of interesting historical material, Duelling Idiots is ideal for those who are fascinated by mathematics and the role it plays in everyday life and in our imaginations.

Across the Board
The Mathematics of Chessboard Problems
John J. Watkins

Across the Board is the definitive work on chessboard problems. It is not simply about chess but the chessboard itself—that simple grid of squares so common to games around the world. And, more importantly, the fascinating mathematics behind it. From the Knight's Tour Problem and Queens Domination to their many variations, John Watkins surveys all the well-known problems in this surprisingly fertile area of recreational mathematics. Can a knight follow a path that covers every square once, ending on the starting square? How many queens are needed so that every square is targeted or occupied by one of the queens?

Each main topic is treated in depth from its historical conception through to its status today. Many beautiful solutions have emerged for basic chessboard problems since mathematicians first began working on them in earnest over three centuries ago, but such problems, including those involving polyominoes, have now been extended to three-dimensional chessboards and even chessboards on unusual surfaces such as toruses (the equivalent of playing chess on a doughnut) and cylinders. Using the highly visual language of graph theory, Watkins gently guides the reader to the forefront of current research in mathematics. By solving some of the many exercises sprinkled throughout, the reader can share fully in the excitement of discovery.

Showing that chess puzzles are the starting point for important mathematical ideas that have resonated for centuries, Across the Board will captivate students and instructors, mathematicians, chess enthusiasts, and puzzle devotees.
The Calculus Lifesaver
All the Tools You Need to Excel at Calculus
Adrian Banner

For many students, calculus can be the most mystifying and frustrating course they will ever take. *The Calculus Lifesaver* provides students with the essential tools they need not only to learn calculus, but to excel at it.

All of the material in this user-friendly study guide has been proven to get results. The book arose from Adrian Banner’s popular calculus review course at Princeton University, which he developed especially for students who are motivated to earn A’s but get only average grades on exams. The complete course will be available for free on the Web in a series of videotaped lectures. This study guide works as a supplement to any single-variable calculus course or textbook. Coupled with a selection of exercises, the book can also be used as a textbook in its own right. The style is informal, non-intimidating, and even entertaining, without sacrificing comprehensiveness. The author elaborates standard course material with scores of detailed examples that treat the reader to an “inner monologue”—the train of thought students should be following in order to solve the problem—providing the necessary reasoning as well as the solution. The book’s emphasis is on building problem-solving skills. Examples range from easy to difficult and illustrate the in-depth presentation of theory.

*The Calculus Lifesaver* combines ease of use and readability with the depth of content and mathematical rigor of the best calculus textbooks. It is an indispensable volume for any student seeking to master calculus.

Calculus Reordered
A History of the Big Ideas
David M. Bressoud

A look at how calculus has evolved over hundreds of years and why calculus pedagogy needs to change

*Calculus Reordered* tells the remarkable story of how calculus grew over centuries into the subject we know today. David Bressoud explains why calculus is credited to seventeenth-century figures Isaac Newton and Gottfried Leibniz, how it was shaped by Italian philosophers such as Galileo Galilei, and how its current structure sprang from developments in the nineteenth century.

Bressoud reveals problems with the standard ordering of its curriculum—limits, differentiation, integration, and series—and he argues that a pedagogy informed by the historical evolution of calculus represents a sounder way for students to learn this fascinating area of mathematics. From calculus’s birth in the Hellenistic Eastern Mediterranean, India, and the Islamic Middle East, to its contemporary iteration, *Calculus Reordered* highlights the ways this essential tool of mathematics came to be.
The Calculus Gallery
Masterpieces from Newton to Lebesgue
William Dunham

More than three centuries after its creation, calculus remains a dazzling intellectual achievement and the gateway to higher mathematics. This book charts its growth and development by sampling from the work of some of its foremost practitioners, beginning with Isaac Newton and Gottfried Wilhelm Leibniz in the late seventeenth century and continuing to Henri Lebesgue at the dawn of the twentieth. Now with a new preface by the author, this book documents the evolution of calculus from a powerful but logically chaotic subject into one whose foundations are thorough, rigorous, and unflinching—a story of genius triumphing over some of the toughest, subtler problems imaginable. In touring The Calculus Gallery, we can see how it all came to be.

The Calculus of Friendship
What a Teacher and a Student Learned about Life while Corresponding about Math
Steven Strogatz

The Calculus of Friendship is the story of an extraordinary connection between a teacher and a student, as chronicled through more than thirty years of letters between them. What makes their relationship unique is that it is based almost entirely on a shared love of calculus. For them, calculus is more than a branch of mathematics; it is a game they love playing together, a constant when all else is in flux. The teacher goes from the prime of his career to retirement, competes in whitewater kayaking at the international level, and loses a son. The student matures from high school math whiz to Ivy League professor, suffers the sudden death of a parent, and blunders into a marriage destined to fail. Yet through it all they take refuge in the haven of calculus—until a day comes when calculus is no longer enough.

Like calculus itself, The Calculus of Friendship is an exploration of change. It’s about the transformation that takes place in a student’s heart, as he and his teacher reverse roles, as they age, as they are buffeted by life itself. Written by a renowned teacher and communicator of mathematics, The Calculus of Friendship is warm, intimate, and deeply moving. The most inspiring ideas of calculus, differential equations, and chaos theory are explained through metaphors, images, and anecdotes in a way that all readers will find beautiful, and even poignant. Math enthusiasts, from high school students to professionals, will delight in the offbeat problems and lucid explanations in the letters.

For anyone whose life has been changed by a mentor, The Calculus of Friendship will be an unforgettable journey.
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