

Quotable Quotes in Mathematics

To most people mathematics is associated with the dull, the difficult, and the uninteresting. Mathematicians are labeled as odd, mad (to quote G. K. Chesterton), esoteric, absentminded, isolated, and unapproachable. One way to dispel these negative feelings towards mathematics in general and mathematicians in particular is to use mathematical aphorisms or quotations in their appropriate context. Quotations are concise packages of thought expressed in such a way as to communicate rich associations and connotations. The following quotations are meant to challenge, interest, humor, delight, and inspire the reader. I have included quotations that I do not agree with (philosophically), but they are still useful in that they will engage the reader to analyze their world view starting points.

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What is Mathematics?

General Definition

Mathematics as an expression of the human mind reflects the active will, the contemplative reason, and the desire for aesthetic perfection. Its basic elements are logic and intuition, analysis and construction, generality and individuality.

Richard Courant and Harold Robbins

Mathematics is on the artistic side a creation of new rhythms, orders, designs, harmonies, and on the knowledge side, is a systematic study of various rhythms, orders, designs and harmonies.

William L. Schaaf

Mathematics is the science of the connection of magnitudes. Magnitude is anything that can be put equal or unequal to another thing. Two things are equal when in every assertion each may be replaced by the other.

Hermann Grassmann, *Stücke aus dem Lehrbuche der Arithmetik, Werke* (Leipzig, 1904), Bk. 2, p. 298.

Pure mathematics consists entirely of such asseverations as that, if such and such a proposition is true of *anything*, then such and such another proposition is true of that thing. It is essential not to discuss whether the first proposition is really true, and not to mention what the anything is of which it is supposed to be true ... If our hypothesis is about *anything* and not about some one or more particular things, then our deductions constitute mathematics. Thus mathematics may be defined as the subject in which we never know what we are talking about, nor whether what we say is true.

Bertrand Russell, *Recent Work on the Principles of Mathematics, International Monthly, Vol. 4 (1901), p. 84.*

There are three ruling ideas, three so to say, spheres of thought, which pervade the whole body of mathematical science, to some one or other of which, or to two or all three of them combined, every mathematical truth admits of being referred; these are the three cardinal notions, of Number, Space and Order. Arithmetic has for its object the properties of number in the abstract. In algebra, viewed as a science of operations, order is the predominating idea. The business of geometry is with the evolution of the properties of space, or of bodies viewed as existing in space.

J. J. Sylvester, *A Probationary Lecture on Geometry, York British Association Report (1844), Part 2; Collected Mathematical Papers, Vol. 2, p. 6.*

Mathematical science is in my opinion an indivisible whole, an organism whose vitality is conditioned upon the connection of its parts. For with all the variety of mathematical knowledge, we are still clearly conscious of the similarity of the logical devices, the *relationship* of the *ideas* in mathematics as a whole and the numerous analogies in its different departments. We also notice that, the farther a mathematical theory is developed, the more harmoniously and uniformly does its construction proceed, and unsuspected relations

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are disclosed between hitherto separated branches of the science. So it happens that, with the extension of mathematics, its organic character is not lost but manifests itself the more clearly.

David Hilbert, *Mathematical Problems*, *Bulletin American Mathematical Society*, Vol. 8, p. 478.

The essence of mathematics lies in its freedom.

Georg Cantor

Mathematics is the science which uses easy words for hard issues.

Edward Kasner and James R. Newman

Mathematics is a body of knowledge, but it contains no truths.

Morris Kline

In mathematical philosophy, formalism is the position that regards mathematics as the study of formal deductive systems. Mathematical truth is simply provability in the system, and there is and can be no ultimate meaning to mathematics other than the operation of naked symbols according to fixed rules.

Philip J. Davis & Reuben Hersh

Strange as it may sound, the power of mathematics rests on its evasion of all unnecessary thought and on its wonderful saving of mental operations.

Ernst Mach

The genuine spirit of Mathesis is devout. No intellectual pursuit more truly leads to profound impressions of the existence and attributes of a Creator, and to a deep sense of our filial relations to him, than the study of these abstract sciences. Who can understand so well how feeble are our conceptions of Almighty Power, as he who has calculated the attraction of the sun and the planets, and weighted in his balance the irresistible force of the lightning? Who can so well understand how confused is our estimate of Eternal Wisdom, as he who has traced out the secret laws which guide the hosts of heaven, and combine the atoms on earth? Who can so well understand that man is made in the image of his Creator, as he who has sought to frame new laws and conditions to govern imaginary worlds, and found his own thoughts similar to those on which his Creator has acted?

Thomas Hill, *The Imagination in Mathematics*
North American Review, Vol. 85, p. 226.

A good definition of mathematics is that it is an abstract formulation of ideas suggested by the patterned structure of God's creation. It is the artful use of the God-given reasoning processes to make connections (find unity in diversity) and then to infer and deduce new facts about creation; i.e., to discover the wisdom of God in Christ hidden in creation (see Proverbs 25:2). It is a series of significant assertions about the nature of creation and its conclusions impact almost all the arts and sciences (either in the context of aesthetical beauty or dominion mandate applications).

James Nickel

Cartesian mathematicism: The long concatenations of simple and easy reasoning which geometricians use in achieving their most difficult demonstrations gave me occasion to imagine that all matters which may enter the human mind were interrelated in the same fashion.

René Descartes

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Human Creation

It is the merest truism, evident at once to unsophisticated observation, that mathematics is a human invention.

P. W. Bridgman

We have overcome the notion that mathematical truths have an existence independent and apart from our own minds. It is even strange to us that such a notion could ever have existed.

Edward Kasner and James R. Newman

The science of pure mathematics, in its modern developments, may claim to be the most original creation of the human spirit.

Alfred North Whitehead

And it seems that the mathematician, in creating his art, is exhibiting that movement of our minds that has created the spatio-temporal material universe we know ... The significance of mathematics resides precisely in the fact that it is an art; by informing us of the nature of our own minds it informs us of much that depends on our minds. It does not enable us to explore some remote region of the eternally existent; it helps to show us how far what exists depends upon the way in which we exist. We are the law-givers of the universe; it is even possible that we can experience nothing but what we have created and that the greatest of our mathematical creations is the material universe itself.

John W. N. Sullivan

To him who is a discoverer in this field the products of his imagination appear so necessary and natural that he regards them, and would like to have them regarded by others, not as creations of thought but as given realities.

Albert Einstein

You could be active in mathematics. You could get inside a good problem and enjoy the discovery of unexpected connections with familiar things. Sometimes, as a result, you had the pleasure of seeing everything anew.

William McGowen Priestley

Finally, a study of mathematics and its contributions to the sciences exposes a deep question. Mathematics is man-made. The concepts, the broad ideas, the logical standards and methods of reasoning, and the ideals which have been steadfastly pursued for over two thousand years were fashioned by human beings. Yet with this product of his fallible mind man has surveyed spaces too vast for his imagination to encompass; he has predicted and shown how to control radio waves which none of our senses can perceive; and he has discovered particles too small to be seen with the most powerful microscope. Cold symbols and formulas completely at the disposition of man have enabled him to secure a portentous grip on the universe. Some explanation of this marvelous power is called for.

Morris Kline

In the presence of so many beautiful creations of his thought the mathematician lives long and lives young: he rejoices in the grandeur of the height to which his controlled imagination attains.

Robert D. Carmichael

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In the pure mathematics we contemplate absolute truths which existed in the divine mind before the morning stars sang together and which will continue to exist there when the last of their radiant host shall have fallen from heaven.

Edward Everett

The spirit of genuine mathematics, i.e., its methods, concepts, and structure – in contrast with mindless calculations – constitutes one of the finest expressions of the human spirit. The great areas of mathematics – algebra, number theory, combinatorics, real and complex analysis, topology, geometry, trigonometry, etc. – have arisen from man's experience of the world that the infinite, personal, Triune, and Sovereign God has created and currently sustains. These branches of mathematics, constructively developed by man made in the image of God, enable man to systematize the given order and coherence (the unity in diversity ... the proximate one and the many) of creation mediated to us by the Creator and upholder of all things – the logos and wisdom of God revealed in the person of the Lord Jesus Christ. This systematization not only gives man a tool whereby he can take effective dominion over the creation under God in Christ, but also gives man the experience and enjoyment of a rich intellectual beauty that borders the sublime in its infinitely complex, yet structured mosaic.

James Nickel

Mathematics and Reality

Some have said that dim aspects of the universe are remotely grasped, not by words, but by mathematics, so difficult are they to express. When the works of creation are so beyond comprehension, to seek to comprehend God [in terms of absolute comprehension, not true comprehension - JN] the Creator is insanity. We must take Him at His word.

Rousas J. Rushdoony, *Systematic Theology*, Vol. 1, p. 196

Mathematics, the science of the ideal, becomes the means of investigating, understanding and making known the world of the real. The complex is expressed in terms of the simple. From one point of view mathematics may be defined as the science of successive substitutions of simpler concepts for more complex

William F. White, *A Scrap-book of Elementary Mathematics* (Chicago, 1908), p. 215.

Mathematics is that form of intelligence in which we bring the objects of the phenomenal world under the control of the conception of quantity.

G. H. Howison, *The Department of Mathematics, and their Mutual Relations Journal of Speculative Philosophy*, Vol. 5, p. 164.

Mathematics is the science of the functional laws and transformations which enable us to convert figured extension and rated motion into number.

G. H. Howison, *The Department of Mathematics, and their Mutual Relations Journal of Speculative Philosophy*, Vol. 5, p. 170.

I believe that mathematical reality lies outside of us. Our function is to discover, or observe it, and that the theorems which we describe grandiloquently as our "creations" are simply notes on our observations.

Godfrey H. Hardy

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One cannot escape the feeling that these mathematical formulas have an independent existence and an intelligence of their own, that they are wiser than we are, wiser even than their discoverers, that we get more out of them than was originally put into them.

Heinrich Hertz

That there is an intimate connection between experimental phenomena and mathematical structures, seems to be fully confirmed in the most unexpected manner by the recent discoveries of contemporary physics ... but we are completely ignorant as to the underlying reasons for this fact ... and we shall perhaps always remain ignorant of them ... Mathematics appears thus as a storehouse of abstract forms ... and it so happens – without our knowing why – that certain aspects of empirical reality fit themselves into these forms, as if through a kind of preadaptation.

Nicholas Bourbaki

... the nature of Mathematics is independent of us personally and of the world outside, and we can feel that our own discoveries and views do not affect the Truth itself, but only the extent to which we or others see it... Some philosophers have reached the startling conclusion that Truth is made by men, and that Mathematics is created by mathematicians, and that Columbus created America ...

Philip E. B. Jourdain

How can it be that mathematics, a product of human thought independent of experience, is so admirably adapted to the objects of reality?

Albert Einstein

The eternal mystery of the world is its comprehensibility.

Albert Einstein

There is no branch of mathematics, however abstract, which may not some day be applied to phenomena of the real world.

Nikolai Lobachevsky

The mathematician, carried along on his flood of symbols, dealing apparently with purely formal truths, may still reach results of endless importance for our description of the physical universe.

Karl Pearson

The miracle of appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning.

Eugene Wigner

How can we, from the point of view of statistical physics, reconcile the facts that the gene structure seems to involve only a comparatively small number of atoms (of the order of 1,000 and possibly less), and that nevertheless it displays a most regular and lawful activity – with a durability or permanence that borders upon the miraculous.

Erwin Schrödinger

How a mathematical structure can correspond to nature is a mystery. One way out is just to say that the language in which nature speaks is the language of mathematics. This begs the question. Often we are both

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shocked and surprised by the correspondence between mathematics and nature, especially when the experiment confirms that our mathematical model describes nature perfectly.

Remo J. Ruffini

If mathematical structures are not in themselves the reality of the world, then they are the only key we possess to that reality.

Morris Kline

Either math is too big for the human mind or the human mind is more than a machine.

Kurt Gödel

There is a pre-established harmony between thought and reality. Nature is the art of God.

Gottfried Wilhelm Leibniz

I have never found a better expression than the expression 'religious' for this trust in the rational nature of reality and of its peculiar accessibility to the human mind. Where this trust is lacking science degenerates into an uninspired procedure. Let the devil care if the priests make capital of this. There is no remedy for that.

Albert Einstein

... the formal interconnections between alternative mathematical theories of the universe suggest that, while absolute truth may not reside in any specific mathematical system, physical truths are indeed intimately connected to mathematical reasoning.

Ernest Zebrowski

... it still seems very curious that pi (3.14159 ...) should be so intrinsically intertwined with the properties of matter, when it initially arose as an abstraction that described ideal circles.

Ernest Zebrowski

[Mathematics] chief attribute is clearness; it has no means for expressing confused ideas. It compares the most diverse phenomena and discovers the secret analogies which unite them. If matter escapes us, as that of air and light because of its extreme tenuity, if bodies are placed far from us in the immensity of space, if man wishes to know the aspect of the heavens at successive periods separated by many centuries, if gravity and heat act in the interior of the solid earth at depths which will forever be inaccessible, mathematical analysis is still able to trace the laws of these phenomena. It renders them present and measurable, and appears to be the faculty of the human mind destined to supplement the brevity of life and the imperfection of the senses, and what is even more remarkable, it follows the same course in the study of all phenomena; it explains them in the same language, as if in witness to the unity and simplicity of the plan of the universe, and to make more manifest the unchangeable order which presides over all natural causes.

Joseph Fourier, *Théorie Analytique de la Chaleur, Discours Préliminaire*.

... mathematics is not the means of denying the idea of God's pre-established world in order to play god and create our own cosmos, but rather is a means whereby we can think God's thoughts after Him. It is a means towards furthering our knowledge of God's creation and towards establishing our dominion over it under God. The issue in mathematics today is root and branch a religious one.

Rousas J. Rushdoony

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The Bible is not a textbook of science; it is a sourcebook of science.

Cornelius Van Til

Mathematicians

Poets are commonly spoken of as psychologically unreliable; and generally there is a vague association between wreathing laurels in your hair and sticking straws in it. Facts and history utterly contradict this view. Most of the very great poets have been not only sane, but extremely business-like; and if Shakespeare ever really held horses, it was because he was much the safest man to hold them. Imagination does not breed insanity. Exactly what does breed insanity is reason. Poets do not go mad; but chess-players do. Mathematicians go mad, and cashiers; but creative artists very seldom.

G. K. Chesterton

... a mathematician may say anything he pleases, but a physicist must be partially sane.

Joshua Willard Gibbs

It is easier to square the circle than to get round a mathematician.

Augustus De Morgan

The Great Architect of the Universe now appears as a pure mathematician.

Sir James Jeans

Sometimes my pencil is more clever than I am.

Leonhard Euler

Once when lecturing to a class he [Lord Kelvin] used the word “mathematician,” and then interrupting himself asked his class: “Do you know what a mathematician is?” Stepping to the blackboard he wrote upon it:

$$\int_{-\infty}^{+\infty} e^{-x^2} dx = \sqrt{\pi}$$

Then putting his finger on what he had written, he turned to his class and said: “A mathematician is one to whom *that* is as obvious as that twice two makes four is to you.”

S. P. Thompson, *Life of Lord Kelvin* (London, 1910), p. 1139.

Mathematics and Other Disciplines

Art (Beauty)

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Who has studied the works of such men as Euler, Lagrange, Cauchy, Riemann, Sophus Lie, and Weierstrass, can doubt that a great mathematician is a great artist? The faculties possessed by such men, varying greatly in kind and degree with the individual, are analogous with those requisite for constructive art. Not every mathematician possesses in a specially high degree that critical faculty which finds its employment in the perfection of form, in conformity with the ideal of logical completeness; but every great mathematician possesses the rare faculty of constructive imagination.

E. W. Hobson, *Presidential Address British Association for the Advancement of Science* (1910)
Nature, Vol. 84, p. 290.

Mathematics - the Subtle Fine Art.

Jamie Byrnie Shaw

Geometry is the archetype of the beauty of the world.

Johannes Kepler

The structures with which mathematics deals are more like lace, the leaves of trees and the play of light and shadow on a human face than they are like buildings and machines, the least of their representatives.

Scott Buchanan

A mathematician, like a painter or a poet, is a maker of patterns. If his patterns are more permanent than theirs, it is because they are made with *ideas*. A painter makes patterns with shapes and colours, a poet with words. A painting may embody an 'idea,' but the idea is usually commonplace and unimportant. In poetry, ideas count for a good deal more; but, as Housman insisted, the importance of ideas in poetry is habitually exaggerated: 'I cannot satisfy myself that there are any such things as poetical ideas Poetry is not the thing said but a way of saying it.'

Not all the water in the rough rude sea
Can wash the balm from an anointed King.

Could lines be better, and could ideas be at once more trite and more false? The poverty of the ideas seems hardly to affect the beauty of the verbal pattern. A mathematician, on the other hand, has no material to work with but ideas, and so his patterns are likely to last longer, since ideas wear less with time than words.

The mathematician's patterns, like the painter's or the poet's, must be *beautiful*; the ideas, like the colours or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics.

G. H. Hardy

The beautiful has its place in mathematics as elsewhere. The prose of ordinary intercourse and of business correspondence might be held to be the most practical use to which language is put, but we should be poor indeed without the literature of imagination. Mathematics too has its triumphs of the creative imagination, its beautiful theorems, its proofs and processes whose perfection of form has made them classic. He must be a "practical" man who can see no poetry in mathematics.

W. F. White, *A Scrap-book of Elementary Mathematics* (Chicago, 1908), p. 208.

A peculiar beauty reigns in the realm of mathematics, a beauty which resembles not so much the beauty of art as the beauty of nature and which affects the reflective mind, which has acquired an appreciation of it, very much like the latter.

E. E. Kummer, *Berliner Monatsberichte* (1867), p. 395

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Architecture, it has been said, is frozen music. Be is so, Geometry is frozen architecture.

Cassius Jackson Keyser

The world of ideas which it [mathematics] discloses or illuminates, the contemplation of divine beauty and order which it induces, the harmonious connection of its parts, the infinite hierarchy and absolute evidence of the truths with which mathematical science is concerned, these, and such like, are the surest grounds of its title of human regard, and would remain unimpaired were the plan of the universe unrolled like a map at our feet, and the mind of man qualified to take in the whole scheme of creation at a glance.

J. J. Sylvester, *A Plea for the Mathematician Nature*, 1, p. 262.

There is no science which teaches the harmonies of nature more clearly than mathematics.

Paul Carus, *Andrens: Magic Squares and Cubes* (Chicago, 1908), Introduction.

Beauty is a conspicuous element in the abstract completeness aimed at in the higher mathematics, it is the goal of physics as it seeks to construe the order of the universe.

John Oman

I have found a very great number of exceedingly beautiful theorems.

Pierre de Fermat

I venture to assert that the feelings one has when the beautiful symbolism of the infinitesimal calculus first gets a meaning, or when the delicate analysis of Fourier has been mastered, or while one follows Clerk Maxwell or Thomson into the strange world of electricity, now growing so rapidly in form and being, or can almost feel with Stokes the pulsations of light that gives nature to our eyes, or track with Clausius the courses of molecules we can measure, even if we know with certainty that we can never see them - I venture to assert that these feelings are altogether comparable to those aroused in us by an exquisite poem or a lofty thought.

W. P. Workman, *F. Spencer: Aim and Practice of Teaching* (New York, 1897), p. 194.

The laws of nature are based upon symmetries that are so sophisticated and so deep that while we may study them with the tools of modern mathematics they lie far above our mental powers to appreciate on an intuitive level - does that not suggest the mind of an artist at work that is far above the level of our own minds?

Stephen M. Barr

Ethics

Let us therefore cultivate with fervor the mathematical sciences, without wishing to extend them beyond their range; and let us not imagine that one could attack the problems of history with mathematical formulas, or that one could sanction the principles of morality by theorems of algebra and calculus.

Augustin-Louis Cauchy

As we mathematize the world, we proceed to lose or to throw away those parts of the world that cannot be mathematized. What isn't mathematized seems not to exist, even never to have existed. We should never forget that a stroll in the woods or a deep conversation with a new or old friend are beyond mathematics. And then, when we go back to our jobs, as administrators, teachers, or whatever, let us still remember that numbers are only the shadow, that life is the reality.

Philip J. Davis & Reuben Hersh

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History

History shows that those heads of empires who have encouraged the cultivation of mathematics, the common source of all the exact sciences, are also those whose reigns have been the most brilliant and whose glory is the most durable.

Michael Charles

I am sure that no subject loses more than mathematics by any attempt to dissociate it from its history.

J. W. L. Glaisher

In most sciences one generation tears down what another has built and what one has established another undoes. In Mathematics alone each generation builds a new story to the old structure.

Hermann Hankel, *Die Entwicklung der Mathematik in den letzten Jahrhunderten* (Tübingen, 1884), p. 25.

Language

Mathematics is a linguistic activity; its ultimate area is preciseness of communication.

William L. Schaaf

Without this language (mathematics) most of the intimate analogies of things would have remained forever unknown to us; and we should forever have been ignorant of the internal harmony of the world, which is the only true objective reality This harmony ... is the sole objective reality, the only truth we can attain; and when I add that the universal harmony of the world is the source of all beauty, it will be understood what price we should attach to the slow and difficult progress which little by little enables us to know it better.

Henri Poincaré, *The Value of Science: Popular Science Monthly, 1906, pp. 195-196.*

Philosophy is written in this grand book, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth.

Galileo

Mathematics, too, is a language, and as concerns its structure and content it is the most perfect language which exists, superior to any vernacular; indeed, since it is understood by every people, mathematics may be called the language of languages. Through it, as it were, nature herself speaks; through it the Creator of the world has spoken, and through it the Preserver of the world continues to speak.

C. Dillmann, *Die Mathematik die Fackelträgerin einer neuen Zeit* (Stuttgart, 1889), p. 5.

Music

May not Music be described as the Mathematic of sense, Mathematic as Music of the Reason? The musician feels Mathematics, the mathematician thinks Music - Music the dream, Mathematic the working life ...

Joseph J. Sylvester

What is the Muse of Life in the World of Ideas? An amateur goddess, high pure, serene, cold towards human frailty, demanding perfect precision of ideas, perfect clarity of expression, and perfect allegiance to

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the eternal laws of thought. In mathematics the name of this muse is familiar - it is Rigor - Logical Rigor, which signifies a mind of silent music, the still harmony of ideas, the intellect, the dream of logical perfection.

Cassius Jackson Keyser

The obvious distinctions between beast and man; thanks to numbers, the cry becomes song, noise acquires rhythm, spring is changed to dance, force becomes dynamic, and outline figures.

Joseph Maistre

A single curve, drawn in the manner of the curve of prices of cotton, describes all that the ear can possibly hear as the result of the most complicated musical performance That to my mind is a wonderful proof of the potency of mathematics.

Lord Kelvin

Philosophy

To create a healthy philosophy you should renounce metaphysics but be a good mathematician.

Bertrand Russell

A mathematical truth is neither simple nor complicated in itself, it is.

Emile Lemoine

It is a safe rule to apply that, when a mathematical or philosophical author writes with a misty profundity, he is talking nonsense.

Alfred North Whitehead, *An Introduction to Mathematics* (New York, 1911), p. 227.

Poetry

It is only the biblical Christian who can truly see and appreciate the “rhyme” of mathematics; its inner “poetry” (resonance) as revealed by a seemingly unending series of connections integrating one branch of mathematics with another and its “rhyme” with the patterns of creation - how the creational laws are in sync and expressed (modeled) in, through, and by mathematical propositions. It is only the biblical Christian who knows the true source for this internal and external rhyme (harmony) - it is the covenantal laws of God in Christ upholding every iota of creation - invisible and visible.

James Nickel

Poetry and mathematics do not belong to distinct cultures, however, despite the small number of people who would profess to truly appreciate them both ... Pope [Alexander - JN] and Newton had something in common after all, that mathematics has within it humanistic elements of the same nature as poetry.

William McGowen Priestley

Mathematicians engage in a kind of collective poetical undertaking by virtue of what has evolved as their common language. To take an example, consider the concept of a function. You may, if you choose, define it in a most unpoetic way as a set of ordered pairs with no first component repeated. Whatever you take the word to denote, the fact is that the concept carries with it a large baggage, much as a single word can carry far-flung connotations. Mathematicians make a function do triple duty. As every student learns early on, a function can be thought of statically, kinematically, or geometrically; that is, as a pair of columns of elements, as a rule of correspondence between moving points, or as a curve. Through this word you may

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move at will, conceptually, in three vastly different realms at once, or shift back and forth until you get the best view. Philosophers of mathematics seem to pay little attention to this point, perhaps because the practice of couching much of mathematics within the language of functions is essentially poetic.

William McGowen Priestley

In every case the awakening touch has been the mathematical spirit, the attempt to count, to measure, or to calculate. What to the poet or the seer may appear to be the very death of all his poetry and all his visions - the cold touch of the calculating mind, - this has proved to be the spell by which knowledge has been born, by which new sciences have been created, and hundreds of definite problems put before the minds and into the hands of diligent students. It is the geometrical figure, the dry algebraical formula, which transforms the vague reasoning of the philosopher into a tangible and manageable conception; which represents, though it does not fully describe, which corresponds to, though it does not explain, the things and processes of nature: this clothes the fruitful, but otherwise indefinite, ideas in such a form that the strict logical methods of thought can be applied, that the human mind can in its inner chamber evolve a train of reasoning the result of which corresponds to the phenomena of the outer world.

J. T. Merz, *A History of European Thought in the Nineteenth Century* (Edinburg and London, 1904), Vol. 1, p. 314.

A mathematician who is not somewhat of a poet will never be a perfect mathematician.

Karl Weierstrass

The union of the mathematician with the poet, fervor with measure, passion with correctness, this is surely the ideal.

William James

A mathematician, like a poet or painter, is a maker of patterns. If his patterns are more permanent than theirs it is because they are made with ideas ... A mathematician ... has no material to work with but ideas, and so his patterns are likely to last longer.

Godfrey H. Hardy

Mathematics, rightly viewed, possesses ... supreme beauty - a beauty cold and austere, like that of sculpture, without appeal to any of our weaker nature, without the gorgeous trappings of paint or music, yet sublimely pure and capable of a stern perfection such as only the greatest art can show. The true spirit of delight, the exaltations, the sense of being more than man, which is the touchstone of excellence, is to be found in mathematics as surely as in poetry.

Bertrand Russell

Baseball

The box score, being modestly arcane, is a matter of intense indifference, if not irritation, to the non-fan. To the baseball-bitten, it is not only informative, pictorial, and gossipy but lovely in aesthetic structure. It represents happenstance and physical flight exactly translated into figures and history. Its totals - batter's credit vs. pitcher's debit - balance as exactly as those in an accountant's ledger. And a box score is more than a capsule archive. It is a precisely etched miniature of the sport itself, for baseball, in spite of its grassy spaciousness and apparent unpredictability, is the most intensely and satisfyingly mathematical of all our outdoor sports. Every player in every game is subjected to a cold and ceaseless accounting; no ball is thrown and no base is gained without an instant responding judgment - ball or strike, hit or error, yea or nay - and an ensuing statistic. This encompassing neatness permits the baseball fan, aided by experience and memory,

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to extract from a box score the same joy, the same hallucinatory reality, that prickles the scalp of a musician when he glances at a page of his score of *Don Giovanni* and actually hears basses and sopranos, woodwinds and violins.

Roger Angell, "The Summer Game"

Natural Science

General Science

Mathematics - the unshaken Foundation of Science, and the plentiful Fountain of Advantage to human affairs.

Isaac Barrow

Mathematics is the door and the key to the sciences.

Roger Bacon

It seems to me that no one science can so well serve to co-ordinate and, as it were, bind together all of the sciences as the queen of them all, mathematics.

E. W. Davis, *Proceedings Nebraska Academy of Sciences for 1896* (Lincoln, 1897), p. 282.

Mathematics stands forth as that which unites, mediates between Man and Nature, inner and outer world, thought and perception, as no other subject does.

Froebel, [*Herford translation*] (London, 1893), Vol. 1, p. 84.

In most sciences one generation tears down what another has built, and what one has established another undoes. In mathematics alone each generation builds a new story to the old structure.

Hermann Hankel

All the effects of nature are only the mathematical consequences of a small number of immutable laws.

Pierre Simon de Laplace

The apodictic quality of mathematical thought, the certainty and correctness of its conclusions, are due, not to a special mode of ratiocination, but to the character of the concepts with which it deals. What is that distinctive characteristic? I answer: *precision, sharpness, completeness* [in terms of the absolutely clear and *indefinable*], of definition. But how comes your mathematician by such completeness? There is no mysterious trick involved; some ideas admit of such precision, others do not; and the mathematician is one who deals with those that do.

Cassius Jackson Keyser, *The Universe and Beyond: Hibbert Journal*, Vol. 3 (1904-1905), p. 309.

It is a fortunate and astonishing fact that the fundamental laws of our fantastic fidgety universe are based on relatively simple equations. If it were otherwise, we surely would know less than we know now about how our universe behaves, and Newton and Leibniz would probably never have invented (or discovered?) calculus.

Martin Gardner

Quotable Quotes in Mathematics

But the ordinary mind cannot help being startled when it finds the entire universe described by science in a few bafflingly specific terms.

Stanley L. Jaki

In Pure Mathematics, where all the various truths are necessarily connected with each other, (being all necessarily connected with those hypotheses which are the principles of science), an arrangement is beautiful in proportion as the principles are few; and what we admire perhaps chiefly in the science, is the astonishing variety of consequences which may be demonstrably deduced from so small a number of premises.

Dugald Stewart, *The Elements of the Philosophy of the Human Mind*, part 3, chap. 1, sect. 3.

Mathematics is the method par excellence by which to investigate, discover, and represent physical phenomena.

Morris Kline

Everywhere in the universe is the evidence of God's majestic design and of His constant and continuous concern to keep the universe running according to plan.

Sir Isaac Newton

The wisdom of the Lord is infinite, so also are His glory and power. Ye heavens, sing His praises! Sun, moon and planets glorify Him in your ineffable language! Celestial harmonies, all ye who comprehend His marvelous works, praise Him. And thou, my soul, praise Thy Creator! It is by Him and in Him that all exists. That which we know best is comprised in Him, as well as in our vain science. To Him be praise, honor, and glory throughout eternity.

Johannes Kepler, *Harmony of the World*

The most beautiful system of sun, planets, and comets could only proceed from the counsel and dominion of an intelligent and powerful Being. This Being governs all things, not as the soul of the world, but as Lord over all.

Sir Isaac Newton

The laws of nature are not laws originating *from* nature, but laws imposed *upon* nature as ordinances of the Creator God.

Abraham Kuyper

A law of nature is an observable pattern or regularity that reflects upon God's covenantal faithfulness through His Son by means of His Spirit.

Donald N. Petcher, *Covenant College*

The covenantal ordinances of God (reflected in our notion of law) are neither "in the mind of God" (idealism) nor part of the creation proper - they represent the mediating activity of God in Christ.

Donald N. Petcher, *Covenant College*

Mathematics is a language suitable for describing the patterned order of creation.

Donald N. Petcher, *Covenant College*

Quotable Quotes in Mathematics

Mathematical law does not explain the patterned order of creation, it merely states the pattern. It does not tell us why the pattern is there.

Donald N. Petcher, *Covenant College*

Physical Sciences

The more progress physical sciences make, the more they tend to enter the domain of mathematics, which is a kind of center to which they all converge. We may even judge of the degree of perfection to which a science has arrived by the facility with which it may be submitted to calculation.

Adolphe Quetelet

Mathematics is the tool specially suited for dealing with abstract concepts of any kind and there is no limit to its power in this field. For this reason a book on the new physics, if not purely descriptive of experimental work, must be essentially mathematical.

Paul Dirac

But there is another reason for the high repute of mathematics. It is mathematics that offers the exact natural sciences a certain measure of security which, without mathematics, they could not attain.

Albert Einstein

The physicist may be satisfied when he has the mathematical scheme and knows how to use it for the interpretation of the experiments. But he has to speak about his results also to non-physicists who will not be satisfied unless some explanation is given in plain language. Even for the physicist the description in plain language will be the criterion of the degree of understanding that has been reached.

Werner Heisenberg

Education

A mathematics teacher is mid-wife to ideas.

George Pólya

I've been giving this lecture to first-year classes for over twenty-five years. You'd think that they would begin to understand it by now.

John Littlewood

I think that no classroom time is better spent than the time devoted to helping students master the classical proofs of the irrationality of square root 2, the infinity of primes, or the Pythagorean theorem.

William McGowen Priestley

Writing is important ... because students cannot learn to think like mathematicians until they learn to write like mathematicians ... they understand the theory behind optimization techniques in calculus if and only if they can properly use a small glossary of words like *let*, *denote*, *then*, *when*, *therefore*, and *attain*. Proper usage of most of these words can be picked up incidentally by knowing - or even by just memorizing - a few classical proofs.

William McGowen Priestley

... get the students to become engaged in mathematics, to know the spirit of delight in the discovery of unexpected connections between things and to acquire a sense of beauty and style in a mathematical

Quotable Quotes in Mathematics

argument - i.e., to know why mathematics is appealing in itself; but ... try also to help the students see mathematics as a significant element in the history of thought that has played a role in our understanding of nature, in the rise of philosophy, and in the development of the liberal arts - i.e., to know how mathematics has interacted with area outside itself.

William McGowen Priestley

Mathematics should be taught in a room, not with mirrors on the walls, but rather with windows to the outside world.

Morris Kline

Psychologically, the teaching of abstractions first is wrong. Indeed, a thorough understanding of the concrete must precede the abstract.

Morris Kline

Mathematics separated from the other sciences loses one of its most important sources of interest and motivation.

Morris Kline

The natural motivation of mathematics is the study of real, largely physical problems.

Morris Kline

The mind is not a vessel to be filled but a fire to be kindled.

Morris Kline

The theory most prevalent among teachers is that mathematics affords the best training for the reasoning powers; ... The modern, and to my mind true, theory is that mathematics is the abstract form of the natural sciences; and that it is valuable as a training of the reasoning powers, not because it is abstract, but because it is a representation of actual things.

T. H. Safford, *Mathematical Teaching etc.* (Boston, 1886), p. 9.

Some educators have soft-pedaled that [students produce right answers to math problems]. In their view, the important thing is that the student hold the right methodological thoughts about the problem, not that the right answer is obtained. Try that one out at the fish market.

Philip J. Davis & Reuben Hersh

Branches of Mathematics

Algebra

Traditional Algebra

In mathematics he was greater than Tycho Brahe or Erra Pater.
For he, by geometric scale, could take the size of pots of ale.
Resolve, by sines and tangents straight, if bread or butter wanted weight;
And wisely tell what hour o'the day the clock does strike, by Algebra.

Samuel Butler

Quotable Quotes in Mathematics

Algebra begins with the unknown and ends with the unknowable.

Anonymous

The best review of arithmetic consists in the study of algebra.

Florian Cajori, *Teaching and History of Mathematics in U.S.* (Washington, 1896), p. 110.

Algebra is generous; she often gives more than is asked of her.

Jean Baptiste le rond D'Alembert

Algebra is the Universal Arithmetic.

Sir Isaac Newton

Algebra is a wonderful invention. It enables fools to do physics without understanding.

Lewis Carroll Epstein

The human mind has never invented a labor-saving machine equal to algebra.

The Nation, Vol. 33, p. 237

The supreme concept of functionality finds its correlate in life in the all-pervasive sense of interdependence and mutual determination among the elements of the world.

Cassius Jackson Keyser, *The Humanization of the Teaching of Mathematics Science, New Series*, Vol. 35, pp. 645-646.

Algebra is but written geometry and geometry is but figured algebra.

Sophie Germain, *Mémoire sur la surfaces élastiques*

Music has much resemblance to algebra.

Novalis, *Schriften, Teil 2* (Berlin, 1901), p. 549.

Modern Algebra

But in the new (math) approach [ca. 1960s - JN] as you know, the important thing is to understand what you're doing, rather than to get the right answer.

Tom Lehrer

The theory of groups is a branch of mathematics in which one does something to something and then compares the results with the result of doing the same thing to something else, or something else to the same thing.

James R. Newman

Analysis (the Calculus and the Concept of Infinity)

Mathematics is the science of the infinite.

Hermann Weyl

The notion of infinity is our greatest friend; it is also the greatest enemy of our peace of mind.

James Pierpont

Quotable Quotes in Mathematics

The infinite! No other question has ever moved so profoundly the spirit of man.

David Hilbert

Infinity belongs unavoidably to God, not only to the very dubious God of Spinoza, but also to the God of the Christian religion.

Alexander Koyre

I could be bounded in a nutshell and count myself a king of infinite space.

William Shakespeare

We admit in geometry not only finite magnitudes, that is to say, magnitudes greater than any assignable magnitude, but infinite magnitudes infinitely greater, the one than the other. This astonishes our dimensions of brain, which is only about six inches long, five broad, and six in depth, in the largest heads.

Voltaire, *A Philosophical Dictionary; Article "Infinity."* (Boston, 1881)

What is man in nature? A nothing in relation to infinity, all in relation to nothing, a central point between nothing and all, and infinitely from understanding either. Then end of things and their beginning are impregnably concealed from him in an impenetrable secret. He is equally incapable of seeing the nothingness out of which he was drawn and the infinite in which he is engulfed.

Blaise Pascal

Reason's last step is the recognition that there are an infinite number of things which are beyond it; it is merely feeble if it does not go so far as to grasp that.

Blaise Pascal

All things began in Order, so shall they end, and so shall they begin again, according to the Ordainer of Order, and the mystical mathematics of the City of Heaven.

Sir Thomas Browne

Even as the finite encloses an infinite series and in the unlimited limits appear, so the soul of immensity dwells in minutia and in narrowest limits no limits inhere. What joy to discern the minute in infinity! The vast to perceive in the small, what divinity!

Jakob Bernoulli

A graduate study at Trinity
Computed the square of infinite.
But it give him the fidgets
To put down the digits,
So he dropped math and took up divinity.

Anonymous

Let x = the number of problems you have.

$\lim_{x \rightarrow \infty} x + 1$ really doesn't make much difference.

James Nickel

Quotable Quotes in Mathematics

In a dark, narrow alley, a function and a differential operator meet, “Get out of my way or I’ll differentiate you ‘til you’re zero!” “Try it—I’m e^x”

The calculus is the greatest aid we have to the appreciation of physical truth in the broadest sense of the word.

W. F. Osgood, *Bulletin American Mathematical Society*, Vol. 13 (1907), p. 467.

[Infinitesimal] analysis is the most powerful weapon of thought yet devised by the wit of man.

W. B. Smith, *Infinitesimal Analysis* (New York, 1898), Preface, p. vii.

Among all the mathematical disciplines the theory of differential equations is the most important It furnishes the explanation of all those elementary manifestations of nature which involve time.

Sophus Lie, *Leipziger Berichte*, 47 (1895); Math.-phys. Classe, p. 262.

Surely no subject in early college mathematics is more exciting or more fun to teach than the calculus. It is like being the ringmaster of a great three-ring circus. It has been said that one can recognize the students on a college campus who have studied the calculus - they are the students with no eyebrows. In utter astonishment at the incredible applicability of the subject, the eyebrows of the calculus students have receded higher and higher and finally vanished over the backs of their heads.

Howard Eves

Arithmetic

Integral numbers are the fountainhead of all mathematics.

H. Minkowski, *Diophantische Approximationen* (Leipzig, 1907), Vorrede.

What would life be without arithmetic, but a scene of horrors?

Sydney Smith

Arithmetic is where numbers fly like pigeons in and out of your head. Arithmetic tells you how many you lose or win if you know how many you had before you lose or win. Arithmetic is numbers you squeeze from your head to your hand to your pencil to your paper till you get the answer. Arithmetic is where the answer is right and everything is nice and you look out of the window and see the blue sky - or the answer is wrong and you have to start all over and try again and see how it comes out this time ... If you ask your mother for one fried egg for breakfast and she gives you two fried eggs, and you eat both of them, who is better in arithmetic, you or your mother?

Carl Sandburg

The law of number explains the wondrous consistency of the laws of nature.

Paul Carus, *Reflections on Magic Squares. Monist*, Vol. 16 (1906), p. 139.

God ever arithmetizes.

C. G. J. Jacobi

Quotable Quotes in Mathematics

Geometry

God is like a skillful Geometrician.

Sir Thomas Browne

God ever geometrizes.

Plato

Geometry existed before the Creation, is co-eternal with the mind of God, is God Himself.

Johannes Kepler

Geometry ... is the science that it hath pleased God hitherto to bestow on mankind.

Thomas Hobbes

Euclid alone has looked on Beauty bare.
Let all who prate of Beauty hold their peace,
And lay themselves prone upon the earth and cease
To ponder on themselves, the while they stare
At nothing, intricately drawn nowhere
In shapes of shifting lineage; let geese
Gabble and hiss, but heroes seek release
From dusty bondage into luminous air.
O blinding hour, O holy, terrible day,
When first the shaft into his vision shone
of light anatomized! Euclid alone
Has looked on Beauty bare. Fortunate they
Who, though once only and then but far away,
Have heard her massive sandal set on stone.

Edna St. Vincent Millay

When I think of Euclid even now, I have to wipe my sweaty brow.

C. M. Bellman

There is no royal road to geometry.

Menaechmus

No one who is not a geometrician may enter our house.

Plato

Space is an infinite sphere whose center is everywhere and whose surface is nowhere.

Cassius Jackson Keyser

The birth of a True Equilateral Triangle from Isosceles parents is the subject of rejoicing in our country
from many furlongs around.

Edwin Abbott

Geometry is that part of universal mechanics which accurately proposes and demonstrates the art of
measuring.

Sir Isaac Newton

Quotable Quotes in Mathematics

Abraham Lincoln (1809-1865), 16th president of the United States “studied and nearly mastered the six books of Euclid when he was a member of Congress. He began a course of rigid mental discipline with the intent to improve his faculties, especially his powers of logic and language. Hence his fondness for Euclid, which he carried with him on the circuit till he could demonstrate with ease all the theorems in the six books; often studying for into the night ... while his fellow-lawyers, half a dozen in a room, filled the air with interminable snoring.”

Biographical sketch, 1860 Presidential Campaign

Euclid’s work ought to have been any educationist’s nightmare. The work presumes to begin from a beginning; that is, it presupposes a certain level of readiness, but it makes no other prerequisites. Yet it never offers any “motivations”, it has no illuminating “asides”, it does not attempt to make anything “intuitive”, and it avoids applications to a fault. It is so “humorless” in its mathematical purism that, although it is a book about “Elements”, it nevertheless does not unbend long enough in its singlemindedness to make the remark, however incidentally, that if a rectangle has a base of 3 inches and a height of 4 inches then it has an area of 12 square inches. Euclid’s work never mentions the name of a person; it never makes a statement about, or even an (intended) allusion to, genetic developments of mathematics In short, it is almost impossible to refute an assertion that the *Elements* is the work of an unsufferable pedant and martinet.

Solomon Bochner

Each and every one of the hundreds of theorems deduced by Euclid could have been worked out with blindfolded eyes in an ivory tower. Nevertheless, when any one of these theorems was applied to a physical situation, it was found that the theorem described the situation perfectly.

Morris Kline

Today, physics has reached the stage of being almost identical with abstract geometry. In fact, the more abstract the geometry is, the better it seems to serve the physicist.

Stanley L. Jaki

Logic, Reason, and Faith

Logic is the anatomy of thought.

John Locke

Logic is the art of going wrong with confidence.

Joseph W. Krutch

“I know what you’re thinking about,” said Tweedledum: “but it isn’t so, nohow.”
“Contrariwise,” continued Tweedledee, “if it was so, it might be; and if it were so, it would be; but as it isn’t, it ain’t. That’s logic.”

Lewis Carroll

The great science [mathematics] occupies itself at least as much with the power of the imagination as with the power of logical conclusion.

Johann Friedrich Herbart, *Werke* (Langensaltza, 1890), Bd. 1, p. 174.

No discovery has been made in mathematics, or anywhere else for that matter, by an effort of deductive logic; it results from the work of creative imagination which builds what seems to be truth, guided sometimes by analogies, sometimes by an esthetic ideal, but which does not hold at all on solid logical bases.

Quotable Quotes in Mathematics

Once a discovery is made, logic intervenes to act as a control; it is logic that ultimately decides whether the discovery is really true or is illusory; its role therefore, though considerable, is only secondary.

Henri Lebesgue

Logic makes us reject certain arguments but it cannot make us believe any argument.

Henri Lebesgue

The moving power of mathematical invention is not reasoning but imagination.

Augustus de Morgan

Man, by logical reasoning, is unable to set up a mathematical system that is both complete and consistent.

Kurt Gödel

... one of the things that math *can* prove is that there is truth beyond math's ability to prove.

Kitty Ferguson

Reasoning leads us from premises to conclusions; it cannot start without premises; ... we must believe that we have an inner sense of values which guides us as to what is to be heeded, otherwise we cannot start on our survey even of the physical world At the very beginning there is something which might be described as an act of faith - a belief that what our eyes have to show us is significant.

Arthur Stanley Eddington

... without a solid faith in the existence of order and law no science is possible. Such a belief ... is not a scientific theory ... it is prescientific, being rooted much deeper in our consciousness than science, it is what makes science possible.

Willem De Sitter

We cannot make much progress with a faith that in this bewildering field of human experience [particle research - JN], which is so new and so much more complicated than we thought even five years ago, there is a unique and necessary order; not an order that we can see without experience, not an order that we can tell a priori, but an order which means that the parts fit into a whole and that the whole requires the parts.

Robert Oppenheimer

Numbers

Mathematics is the queen of the sciences and number theory the queen of mathematics.

Karl Friedrich Gauss

God made the integers; all else is the work of man.

Leopold Kronecker

Wherefore as without numbering a man can do almost nothing, so with the help of it you may attain to all things.

Robert Recorde

If number be lacking it maketh men dumbe, so that to most questions they must answer Mum.

Robert Recorde

Quotable Quotes in Mathematics

Number [positive integers - JN] rules the universe.

Motto of the Pythagoreans

All things which can be known have number [positive integers - JN]; for it is not possible that without number anything can be either conceived or known.

Philolaus

All results of the profoundest mathematical investigation must ultimately be expressible in the simple form of properties of the integers.

Leopold Kronecker

Thus number may be said to rule the whole world of quantity, and the four rules of arithmetic may be regarded as the complete equipment of the mathematician.

James Clerk Maxwell

There is no inquiry which is not finally reducible to a question of numbers; for there is none which may not be conceived of as consisting in the determination of quantities by each other, according to certain relations.

Auguste Comte

The Social Tyranny of Numbers:

Mathematics 201

MWF 11:00 AM, Room 301, Ivy Building A

Professor: S. T. Atistics

Teaching Assistant: Norman Curve

Final Exam:

<i>Student ID</i>	<i>Grade</i>
067-45-1789	67
118-45-4987	76
178-90-8872	92
291-34-1145	72
336-76-1455	98
399-42-0089	82
412-34-1097	85
555-34-1890	58
576-15-1572	65
765-14-8004	72
797-00-9901	79
812-88-6547	62
942-65-1787	85

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956-17-7633	80
Average	76.64286
Sigma	11.47309
Median	77.5

Game Theory

At the end of his course on mathematical methods in optimization, the professor sternly looked at his students and said, "There is one final piece of advice I'm going to give you now - whatever you have learned in my course, never, ever try to apply it to your personal lives!"

"Why?" the students asked.

"Well, some years ago, I observed my wife preparing breakfast, and I noticed that she wasted a lot of time walking back and forth in the kitchen. So, I went to work, optimized the whole procedure, and told my wife about it."

"And what happened?"

"Before I applied my expert knowledge, my wife needed about half an hour to prepare breakfast for the two of us. And now, it takes me less than fifteen minutes. . . ."

Life is a game, the object of which is to discover the object of the game.

Sander's Rumination

Laws of thermodynamics:

1. You cannot win.
2. You cannot break even.
3. You cannot get out of the game.

L. Mackay

Probability

We see ... that the theory of probabilities is at bottom only common sense reduced to calculation.

Pierre Simon de Laplace

The probability of anything happening is in inverse ratio to its desirability.

Gumperson's Law

The lot is cast into the lap; but the whole disposing thereof is of the LORD.

Proverbs 16:33

Statistics

That nothing happens by accident is, of course, a chief tenet of Christian religion, according to which not even a sparrow falls to the ground, or a hair is bent on our head, without our Heavenly Father willing it. That nothing happens by accident - that is, by sheer chance, that is, really without a cause - is also a chief tenet of science about the material universe. For if anything were truly accidental, there could be no consistency, and without consistency there could be no laws, not even statistical laws, because even they imply one or two parameters which imply consistency.

Quotable Quotes in Mathematics

Stanley L. Jaki

The object of statistics is to discover methods of condensing information concerning large groups of allied facts into brief and compendious expressions suitable for discussion.

Francis Galton

Statistics is the heart of democracy.

Simeon Strunsky

Statistics is a group of numbers looking for an argument.

Anonymous

He uses statistics as a drunken man uses lamp posts for support rather than illumination.

Andrew Lang

There are three kinds of lies: lies, damned lies, and statistics.

Benjamin Disraeli

Statistician: A man who drove a mathematically precise line from an unwarranted assumption to a forgone conclusion.

Anonymous

If a man stood with one foot in a hot oven and the other foot in a freezer, statisticians would say that on the average he was comfortable.

Quote Magazine (29 June 1975)

Round numbers are always false.

Samuel Johnson

An average guy.

Harold Coffin

Do you know that 87.166253% of all statistics claim a precision that is not justified by the method employed?

Mathematics and Humor

A mathematician meets an old friend, and notices that he has become rich. "How did this happen?" he asks. "Gambling," answers the friend. "One night I dreamed of six wagons, each with 7 horses. I immediately knew that my luck number is 6 times 7, which is 43. I bet all my money on horse number 43, and indeed it won." "But 6 times 7 is 42!" cries the mathematician indignantly. "Really?" says the friend. "Well, you're the mathematician."

Cited by Ron Aharoni

Why do mathematicians often confuse Christmas with Halloween? Because $\text{Oct } 31 = \text{Dec } 25$.

"Can you do addition?" the White Queen asked. "What's one and one and one and one and one and one and one and one and one and one?"

"I don't know," said Alice, "I lose count."

Lewis Carroll

Quotable Quotes in Mathematics

“Reeling and Writhing, of course, to begin with,” the Mock Turtle replied; “And then the different branches of Arithmetic - Ambition, Distraction, Uglification, and Derision.”

Lewis Carroll

I think that I shall never c
A # lovelier than 3
For $3 < 6$ or 4,
And then 1 it's slightly more.
All things in nature come in 3's
Like triangles, trios, Q.E.D.'s
White \$\$ gain more dignity
if augmented 3×3 ...

John Atherton

I had been to school ... and could say the multiplication tables up to $6 \times 7 = 35$, and don't reckon I could ever get any further than if I was to live forever. I don't take stock of mathematics.

Mark Twain, *Huckleberry Finn*

“When I use a word,” Humpty Dumpty said in a rather scornful tone, “it means just what I choose it to mean - neither more nor less.”

“The question is,” said Alice, “whether you can make words mean different things.”

“The question is,” said Humpty Dumpty, “which is to be master - that's all.”

Lewis Carroll

A statistician is one who collects data and draws confusion.

H. M. Berston

A mathematician fell madly in love
with a lady, young, handsome, and charming;
By angles and ratios harmonic he strove
Her curves and proportions all faultless to prove,
As he scrawled hieroglyphics alarming.

“Let x denote beauty, - y , manners well-bred, -

“ ζ Fortune, - (this last is essential), -

“Then L is a function of x, y , and ζ

Of the kind which is known as potential.”

Now integrate L with respect to dt ,

“(t Standing for time and persuasion);

“Then, between proper limits, 'tis easy to see,

“(A very concise demonstration).”

Said he - “If the wandering course of the moon

“By Algebra can be predicted,

“The female affections must yield to it soon” -

- But the lady ran off with a dashing dragoon,

And left him amazed and afflicted.

William J. M. Rankine

Quotable Quotes in Mathematics

The Evolution of Teaching Math:

Teaching Math in 1950: A logger sells a truckload of lumber for \$100. His cost of production is $\frac{4}{5}$ of the price. What is his profit?

Teaching Math in 1960: A logger sells a truckload of lumber for \$100. His cost of production is $\frac{4}{5}$ of the price, or \$80. What is his profit?

Teaching Math in 1970: A logger exchanges a set “L” of lumber for a set “M” of money. The cardinality of set “M” is 100. Each element is worth one dollar. Make 100 dots representing the elements of the set “M.” The set “C,” the cost of production, contains 20 fewer points than set “M.” Represent the set “C” as a subset of set “M” and answer the following question: What is the cardinality of the set “P” for profits?

Teaching Math in 1980: A logger sells a truckload of lumber for \$100. Her cost of production is \$80 and her profit is \$20. Your assignment: Underline the number 20.

Teaching Math in 1990: By cutting down beautiful forest trees, the logger makes \$20. What do you think of this way of making a living? Topic for class participation after answering the question: How did the forest birds and squirrels feel as the logger cut down the trees? There are no wrong answers.

Teaching Math in 1996: By laying off 40% of its loggers, a company improves its stock price from \$80 to \$100. How much capital gain per share does the CEO make by exercising his stock options at \$80? Assume capital gains are no longer taxed, because this encourages investment.

Teaching Math in 1997: A company outsources all of its loggers. The firm saves on benefits, and when demand for its product is down, the logging work force can easily be cut back. The average logger employed by the company earned \$50,000, had three weeks vacation, a nice retirement plan and medical insurance. The contracted logger charges \$50/hour. Was outsourcing a good move?

Teaching Math in 1998: A laid-off logger with four kids at home and a ridiculous alimony from his first failed marriage comes into the logging-company corporate offices and goes postal, mowing down 16 executives and a couple of secretaries, and gets lucky when he nails a politician on the premises collecting his kickback. Was outsourcing the loggers a good move for the company?

Teaching Math in 1999: A laid-off logger serving time in Folsom for blowing away several people is being trained as a COBOL programmer in order to work on Y2K projects. What is the probability that the automatic cell doors will open on their own as of 00:00:01, 01/01/00?

Applications of Mathematics

The Importance of Mathematics

The advance and perfecting of mathematics are closely joined to the prosperity of the nation.

Napoleon Bonaparte

The merit of painting lies in the exactness of reproduction. Painting is a science and all sciences are based on mathematics. No human inquiry can be a science unless it pursues its path through mathematical exposition and demonstration.

Leonardo da Vinci

Neglect of mathematics works injury to all knowledge since he who is ignorant of it cannot know the other sciences or the things of this world.

Roger Bacon

Quotable Quotes in Mathematics

Mathematics, like the Nile, begins in minuteness, but ends in magnificence.

Charles Caleb Colton

[When followed in the proper spirit], there is no study in the world which brings into more harmonious action all the faculties of the mind than the one [mathematics] of which I stand here as the humble representative and advocate. There is none other which prepares so many agreeable surprises for its followers, more wonderful than the transformation scene of a pantomime, or, like this, seems to raise them, by successive steps of initiation to higher and higher states of conscious intellectual being.

J. J. Sylvester, *A Plea for the Mathematician*, *Nature*, Vol. 1, p. 261

The motive for the study of mathematics is insight into the nature of the universe. Stars and strata, heat and electricity, the laws and processes of becoming and being, incorporate mathematical truths. If language imitates the voice of the Creator, revealing His heart, mathematics discloses His intellect, repeating the story of how things came into being. And the value of mathematics, appealing as it does to our energy and to our honor, to our desire to know the truth and thereby to live as of right in the household of God, is that it establishes us in larger and larger certainties. As literature develops emotion, understanding, and sympathy, so mathematics develops observation, imagination, and reason.

W. E. Chancellor, *A Theory of Motives, Ideals and Values in Education* (Boston and New York, 1907), p. 406.

The usefulness of Mathematics

I must study politics and war that my sons may have liberty to study mathematics and philosophy. My sons ought to study mathematics and philosophy, geography, natural history, naval architecture, navigation, commerce and agriculture in order to give their children a right to study painting, poetry, music, architecture, statuary, tapestry, and porcelain.

John Adams (1735-1826), letter to Abigail Adams, May 12, 1780

The tantalizing and compelling pursuit of mathematical problems offers mental absorption, peace of mind amid endless challenges, repose in activity, battle without conflict, refuge from the goading urgency of contingent happenings, and the sort of beauty changeless mountains present to the senses tried by the present-day kaleidoscope of events.

Morris Kline

Mathematics in its pure form, as arithmetic, algebra, geometry, and the applications of the analytic method, as well as mathematics applied to matter and force, or statics and dynamics, furnishes the peculiar study that gives to us, whether as children or as men, the command of nature in this its quantitative aspect; mathematics furnishes the instrument, the tool of thought, which we wield in this realm.

W. T. Harris, *Psychologic Foundations of Education* (New York, 1898), p. 325.

Little can be understood of even the simplest phenomena of nature without some knowledge of mathematics, and the attempt to penetrate deeper into the mysteries of nature compels simultaneous development of the mathematical processes.

J. W. A. Young, *The Teaching of Mathematics* (New York: 1907), p. 16.

Mathematics exists primarily to help man understand and master the physical world.

Morris Kline

Quotable Quotes in Mathematics

Mathematics is the key to our understanding of the physical world; it has given man power over nature and it has given man the conviction that he can continue to fathom the secrets of nature.

Morris Kline

Mathematics accomplishes really nothing outside of the realm of magnitude; marvellous, however, is the skill with which it masters magnitude wherever it finds it. We recall at once the network of lines which it has spun about heavens and earth; the system of lines to which azimuth and latitude, declination and right ascension, longitude and latitude are referred; those abscissas and ordinates, tangents and normals, circles of curvature and evolutes; those trigonometric and logarithmic functions which have been prepared in advance to await application. A look at this apparatus is sufficient to show that mathematicians are not magicians, but that everything is accomplished by natural means; one is rather impressed by the multitude of skilful machines, numerous witnesses of a manifold and intensely active industry, admirably fitted for the acquisition of true and lasting treasures.

J. F. Herbart, *Werke* (Langensalza, 1890), Bd. 5, p. 101

... what is physical is subject to the laws of mathematics, and what is spiritual to the laws of God, and the laws of mathematics are but the expression of the thoughts of God.

Thomas Hill, *The Uses of Mathesis, Bibliotheca Sacra*, Vol. 32, p. 523.

Doubtless the reasoning faculty, the mind, is the leading and characteristic attribute of the human race. By the exercise of this, man arrives at the properties of the natural bodies. This is science, properly and emphatically so called. It is the science of pure mathematics; and in the high branches of this science lies the truly sublime human acquisition. If any attainment deserves that epithet, it is the knowledge, which, from the mensuration of the minutest dust of the balance, proceeds on the rising scale of material bodies, everywhere weighing, everywhere measuring, everywhere detecting and explaining the laws of force and motion, penetrating into the secret principles which hold the universe of God together, and balancing worlds against worlds, and system against system.

Daniel Webster, *Works* (Boston, 1872), Vol. 1, p. 180.

Mathematics has a triple end. It should furnish an instrument for the study of nature. Furthermore it has a philosophic end, and, I venture to say, an end esthetic. It ought to incite the philosopher to search into the notions of number, space, and time; and, above all, adepts find in mathematics delights analogous to those that painting and music give. They admire the delicate harmony of number and of forms; they are amazed when a new discovery discloses for them an unlooked for perspective; and the joy they thus experience, has it not the esthetic character although the senses take no part in it? Only the privileged few are called to enjoy it fully, it is true; but is it not the same with all the noblest arts? Hence I do not hesitate to say that mathematics deserves to be cultivated for its own sake, and that the theories not admitting of application to physics deserve to be studied as well as others.

Henri Poincaré, *The Relation of Analysis and Mathematical Physics, Bulletin American Mathematical Society*, Vol. 4 (1899), p. 248.

Mathematics make the mind attentive to the objects which it considers. This they do by entertaining it with a great variety of truths, which are delightful and evident, but not obvious. Truth is the same thing to the understanding as music to the ear and beauty to the eye. The pursuit of it does really as much gratify a natural faculty implanted in us by our wise Creator as the pleasing of our senses: only in the former case, as the object and faculty are more spiritual, the delight is more pure, free from regret, turpitude, lassitude, and intemperance that commonly attend sensual pleasures.

John Arbuthnot, *Usefulness of Mathematical Learning*

Quotable Quotes in Mathematics

Pure and Applied Mathematics

Much of the best mathematical inspiration comes from experience. It is hardly possible to believe in the existence of an absolute immutable concept of mathematical rigor dissociated from all human experience.

John von Neumann

The object of pure Physics is the unfolding of the laws of the intelligible world; the object of pure Mathematic that of unfolding the laws of human intelligence.

J. J. Sylvester, *On a theorem connected with Newton's Rule*, *Collected Mathematical Papers, Vol. 3, p. 424*.

It may well be doubted whether, in all the range of science, there is any field so fascinating to the explorer - so rich with hidden treasures - so fruitful in delightful surprises - as Pure Mathematics.

Lewis Carroll

The applied mathematician can find the solution to any difficulty whilst the pure mathematician can find the difficulty to any solution.

Anonymous

“Applied Mathematics!” ... There is, strictly speaking, no such thing. Applied Mathematics is mathematics or it is not mathematics at all ... And I suppose we are fated yet to hear of applied glory, applied holiness, applied poetry ... applied joy, applied ontology, yet of applied inapplicability itself?

Cassius Jackson Keyser

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