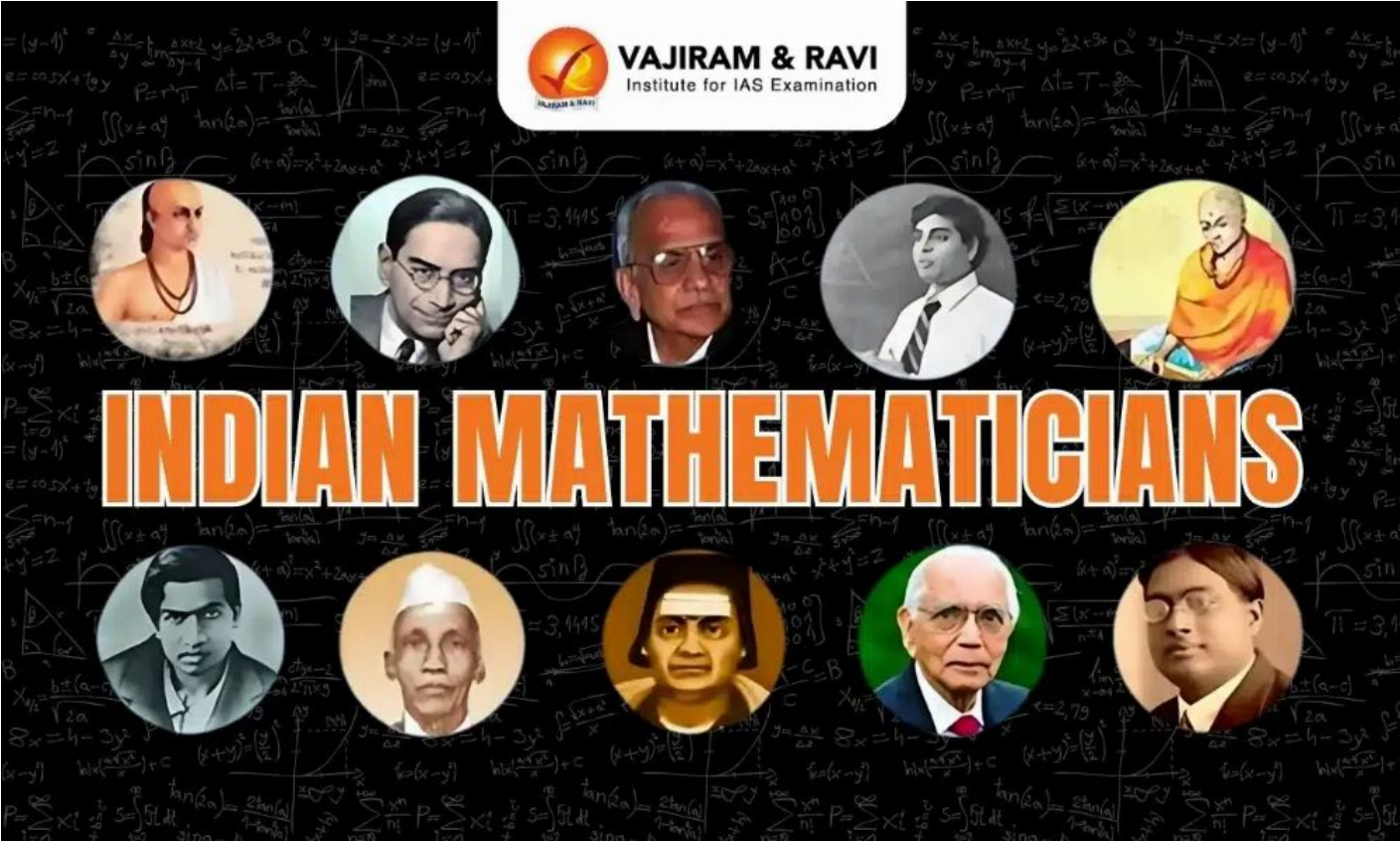


Indian Mathematicians

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India's contributions to pathbreaking discoveries made by mathematics date back to ancient and medieval times. From formulating geometric principles in the ancient era to pioneering concepts of calculus centuries before Europe, **Indian mathematicians** like Ramanujan made profound contributions to mathematical analysis in the modern period.

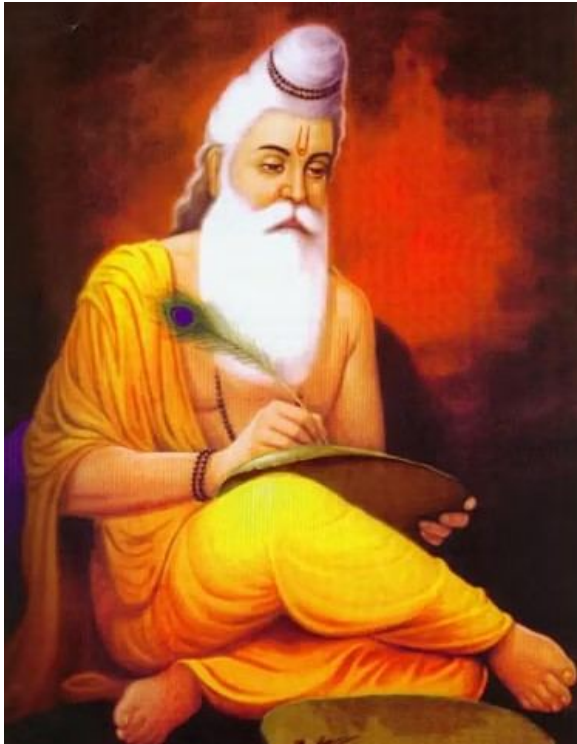
Contemporary Indian mathematicians are expanding frontiers in diverse domains, garnering global recognition, exploring the enduring legacy and monumental contributions of mathematicians from India across different eras, and highlighting their timeless influence on the evolution of mathematical knowledge.

List of Famous Indian Mathematicians and their Contributions

The origins of Indian mathematics date back to the Indus Valley Civilization around **3000 BCE**. Concepts of geometry, arithmetic, and algebra saw systematic development starting from this period through the **classical age** around 500 CE. Here is the list of Indian mathematicians and their key contributions:

Name	Key Contribution
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Baudhayana (800 BCE)



- **Books:** Ancient Indian mathematical texts like the **ShrautaSutras** and **Sulba Sutras** contain early geometric theories and concepts.

- Notably, the **Baudhayana Sulba Sutra** (today known as the Pythagorean theorem) was formulated around 1000 BC, centuries before Pythagoras.

Katyayana (300 BCE)

- Wrote commentaries on **Sanskrit grammar** and the **Sulba Sutras**.

- His work on **geometry** and **Pythagorean triples** guided later mathematicians.

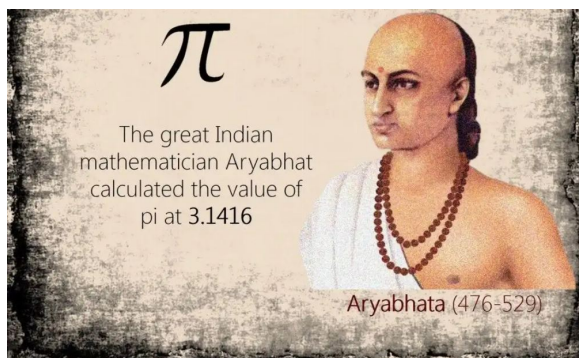
Pingala (500 BCE)



- Developed the **binary number system** and **Pascal's triangle**.

- The former proved fundamental to the development of **modern computing**, while the latter laid the foundation for **combinatorics**.

Aryabhata (476-529 CE)



- The most influential mathematician from ancient India who transformed **astronomy** and **mathematics**.

- The computed value of **Pi(π)** accurately and properties of trigonometric functions like a **sine**.

- This improved astronomical calculations.

- Derived **rotation of the Earth on its axis** and caused lunar and solar eclipses, dispelling prevailing myths.

- Invented one of the **first decimal number systems** and algorithms for solving algebraic equations.

- His numeral system and place value system aided complex calculations.

- Determined the **circumference of the earth** within 99 miles of actual value through innovative techniques.

- **Book: Aryabhatiya** (Consolidated Indian mathematics in his seminal work)

- It contains astronomy models and arithmetic/algebra methods.

Varahamihira (505-587 CE)

- Eminent astronomer who published major encyclopedias on astronomy, astrology and other sciences.

- **Books: Brihat Samhita** and **Pancha Siddhantika**

- Contributions: **combinatorics, predicting eclipses, trigonometry** and mathematical astrology.

- Pioneer of the **East Indian school of astronomy** that flourished after Aryabhata.

Brahmagupta (598-670 CE)	- Revolutionised arithmetic and algebra in medieval India through his mathematical treatises. - Explained rules for operations with negative numbers and zero, a breakthrough in arithmetic. - Derived methods for solving certain indeterminate equations and quadratic equations. - Provided a foundation for developing residue mathematics, a precursor to modern number theory. - Contributed to geometry with accurate formulae for triangles, circles, and other shapes. • Showed a link between algebra and geometry. - Solved linear equations using matrices, a milestone in the development of modern linear algebra. - Book: Brahma-sputa-Siddhanta
Bhaskara I (600-680 CE)	- Built on Aryabhata's work to enrich astronomy and mathematics. - Derived an approximation formula for the sine function, improving trigonometric calculations. - Book: Mahabhaskariya -contained innovative arithmetic and geometry.
Shridhara (650-850 CE)	- Made an important contribution in calculating the volume of the sphere. - Using infinitesimal slicing, derived formula for the volume of the sphere as two-thirds of the circumscribing cylinder's volume. - Pioneered early concepts of integral calculus, centuries before Kepler or Cavalieri.

Mahavira (9th century CE)	- Jain mathematician - Book: Ganita Sara Sangraha-the earliest surviving Sanskrit text on algebra - Solved algebraic equations, quadratic equations and problems involving fractions systematically. - Covered permutations, combinations, series arithmetic and geometric progressions. - Influenced later Kerala school mathematicians with his work in algebra.
Bhaskara II (1114-1185 CE)	- Outstanding mathematician - Developed some principles of differential calculus and solved various astronomical problems. - Derived the Bhaskara's Wheel formula for all quadratic equations and an approximation of the sine function. - Book: 'Lilavati' on arithmetic and algebra
Narayana Pandit (1340-1400 CE)	- Books: Composed two influential texts - Ganita Kaumudi and Bijaganita Vatamsa - advancing number theory and algebraic solutions. - Derived methods for finding integral solutions for indeterminate equations using the 'kuttaka' method.

Madhava (c. 1340-1425 CE)	- The founder of the Kerala School of Mathematics and Astronomy who pioneered calculus centuries before Newton. - Developed the infinite Newton-Gauss series to calculate Pi(π) accurately to 11 decimal places. - Derived properties of sine and cosine functions and the Madhava-Gregory series for inverse tangent. - Discovered Taylor series approximation, power series and concepts of analysis centuries before European mathematicians. - Pioneered tests of convergence and analytical tools that laid the foundations for the development of calculus. - Inspired brilliant mathematicians like Nilakantha Somayaji and Jyesthadeva who further advanced Kerala mathematics.
Parameshvara (1360-1455 CE)	- A Leading astronomer from the Kerala school after Madhava. - Made observations and calculations to revise parameters in astronomical models following Madhava. - Authored commentaries on works by Aryabhata, Bhaskara and others. Helped preserve their mathematical legacy. - Expanded studies of planetary models, eclipses, trigonometry and spherical geometry.

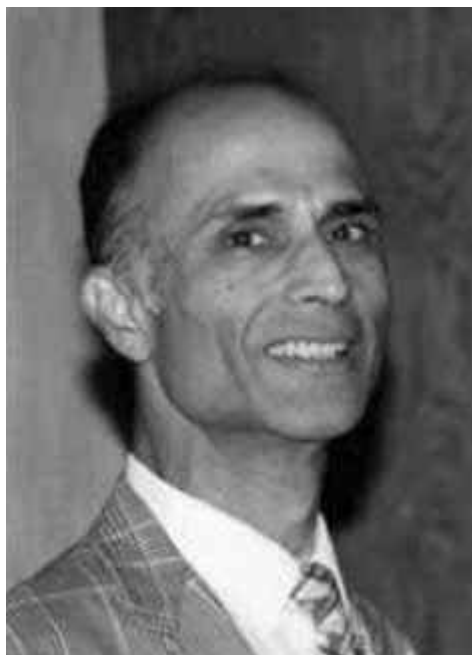
Nilakantha Somayaji (1444-1545 CE)	- Giant of the Kerala school who expanded on infinite series to make major contributions. - Computed Pi(π) accurate to 9 decimals by improving Madhava's series; removed empirical elements. - Derived more accurate approximations of trigonometric functions using infinite series. - Studied cyclic quadrilaterals and combinatorics. Anticipated concepts of calculus. - Authored a comprehensive astronomical treatise Tantra-sangraha in Sanskrit verse, covering his mathematical discoveries.
Jyeshtadeva (1500 CE)	- Authored the first calculus text Yukti-bhāṣā based on Kerala school's principles. - Explained and proved major results discovered by Madhava using a clear step-by-step approach. • Derived and verified properties of sine, cosine, and inverse tangent series. • Solved indeterminate equations using calculus techniques. • Pioneered a new problem-solving methodology.

Srinivasa Ramanujan (1887-1920)



- Derived over **3900 mathematical theorems** and **equations** during his short lifetime.
- Made groundbreaking findings across **analytic number theory, theory of partitions, numerical series, continued fractions** etc. without formal training.
- Discovered exotic mathematical objects like **mock theta functions** which laid the foundation for an entire new area of research.
- Formulated original and influential theories in fields like **probabilistic number theory, combinatorics, Fourier analysis, prime number theory** etc.
- Discovered mathematical principles like the **Ramanujan prime, Ramanujan theta function, Ramanujan's sum** and the **Ramanujan conjecture**.
- Through collaborations with Hardy, proved theorems related to **partition dimensions** and made major discoveries in **analytic number theory**.
- Transformed 20th-century mathematics and opened entirely new vistas for future research through his brilliant, unconventional ideas.
- Physicists used Ramanujan's work on **partitions and mock theta forms** to derive the **quantum entropy of certain black holes**.

Harish Chandra (1923-1983)



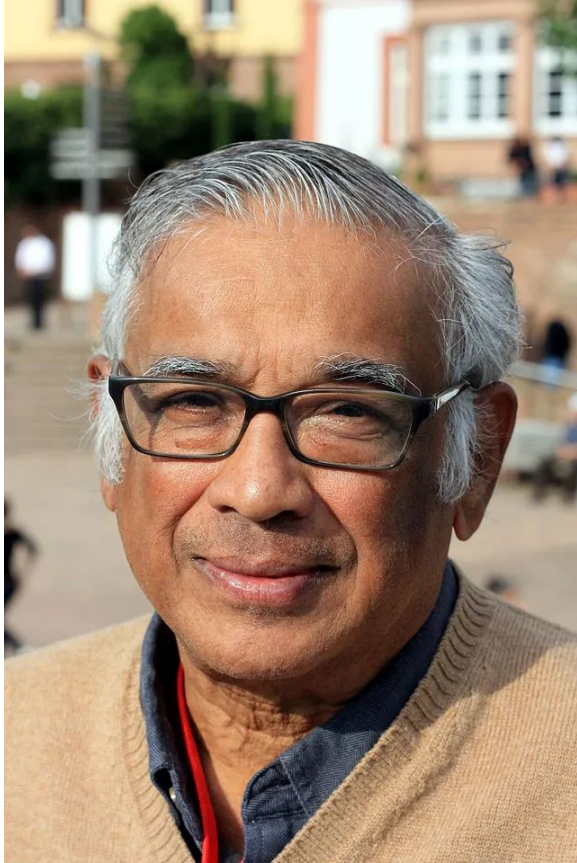
- Transformed representation theory of **Lie groups** and its applications in physics
- Developed foundational theorems regarding representations of **semisimple Lie groups** and **harmonic analysis**.
- Furthered **Langland's program** connects representation theory and automorphic forms.
- Worked with mathematical luminaries like **Weil**, **Selberg**, and **Siegel** to exchange ideas and collaborate.
- Set up the **Harish-Chandra Research Institute** to nurture mathematics research and education in India.

C.R. Rao (1920-2023)



- Pioneer of modern statistics and econometrics who revolutionized statistical theory.
- Developed theoretical foundations for multivariate analysis and statistical inference.
- Formulated the renowned **Cramér-Rao** bound on the variance of estimators, along with the **Rao-Blackwell theorem**.
- Advanced methodologies like the **Rao distance metric** and **Rao test** are still in use.
- Shaped the direction of **econometrics** through causality analysis models and other innovations.

S. Varadhan (1940-)



- Contributions to probability theory and stochastic processes.
- Pioneered the **theory of large deviations** and **stochastic calculus techniques**.
- Developed **Brownian motion process theory** and **martingale tools** used in finance theory.
- **Awards:** Fields Medal in **Probability Theory**, Abel Prize and National Science Medal.
- Collaborated with leading mathematicians like **Monroe D. Donsker** to advance probability theory.

Applications of Indian Mathematics

Discoveries by Indian mathematicians continue to find novel applications decades and centuries later, proving the timelessness of their work. Some examples:

- **Satellite Navigation** - Uses formulae for spherical geometry and trigonometry derived by mathematicians like **Aryabhata** and **Brahmagupta**.
- **Computer Graphics** - Infinite series properties studied by **Madhava** and solutions using **Pell's equations** aid 3D modelling and animation.
- **Fluid Dynamics** - Equations formulated by classical Indian mathematicians help accurately model phenomena like **turbulence for applications** in aerospace engineering.
- **Cryptography** - **Number theory results, infinite series** and **combinatorics** tools devised centuries ago are applied in **cryptography** and **cybersecurity** today.
- **Modeling** - Ancient mathematical techniques form the basis for **epidemiological** and **weather prediction models**. They also find use in **artificial intelligence** and **data science algorithms**.

The universal nature of mathematical truth enabled Indian geniuses to make contributions that continued to hold relevance centuries later. The foundation laid by them ushered in an era of modern mathematics globally.

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