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An Attempt to Derive Mathematical Theorems from Vedic Sub-Sutras

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Abstract : The Vedas are the most ancient knowledge reservoir of Hindu philosophy. Bharati Krishna Tirtha Ji developed Vedic mathematics after eight years of intensive study of the Vedas. He extracted mathematical concepts from the Vedas and developed Vedic mathematics, which consists of sixteen sutras and thirteen sub-sutras. This paper investigates the translation of ancient Vedic Mathematics sub-sutras into formal mathematical theorems. Vedic Mathematics, celebrated for its intuitive and effective mental calculation methods, is reexamined through the lens of contemporary mathematics. The analysis begins with summarizing significant Vedic sub-sutras, highlighting their historical significance and practical uses. Each sub-sutra is rephrased into a formal theorem with clear definitions, criteria, and applicable domains. Where appropriate, detailed proofs are included, showcasing the validity of the established theorems within modern mathematical reasoning. This research aims to connect ancient mathematical knowledge with modern theory, illustrating the relevance of Vedic methods for today's mathematicians, educators, and learners, while also proposing future research opportunities.

IndexTerms - Vedic Mathematics, Proofs, Sutras, Sub-Sutras, Mathematical Theorems, Modern Mathematics, Vedic Theorems.

I. INTRODUCTION

The Veda is one of the most ancient texts of Eastern philosophy. The word "Veda" refers to the warehouse of all knowledge. [1]The Sanskrit term "Veda" means knowledge or information, and it represents the source and boundless repository of all fundamental knowledge for humanity. The Vedas are considered the first words of Vedic tradition, and they refer to the sacred ancient Hindu texts, which are divided into four parts: the Rig-Veda, Yajur Veda, Sam Veda, and Atharva Veda. The Atharva Veda, often called the "Veda of magical formulas," is a primary source of knowledge about Vedic culture. Topics covered in the Vedas include Grammar, Astronomy, Architecture, Psychology, Philosophy, Economics, Medicine, and Archery. "Vedic Mathematics" refers to a highly efficient method of computation based on simple principles and techniques. Vedic Mathematics answers in one line, whereas the ordinary technique requires a few stages[2]

The Rigveda, Samaveda, Yajurveda, and Atharvaveda are the four main volumes of the Vedas. The Vedas are regarded as the most ancient scripture of Eastern philosophy, encompassing religious and ritual poetry and formulae.[3] "Vedic Mathematics" is now recognized as a distinct and important branch of mathematics. Vedic mathematics is an ancient system of mathematics based on sixteen sutras and thirteen sub-sutras[4]. Fast calculation is a key feature of Vedic mathematics. [1].

The transformation of Vedic Sub-Sutras into formal theorems involves a structured approach: first, outlining the specific terms and conditions for each Sub-sutra's application; next, presenting each Sub-sutra in a clear, unambiguous way; and finally, constructing formal proofs to confirm their validity. This process not only retains the original power and practicality of the Sub-sutras but also brings them in line with the strict logical standards expected in modern mathematics.

In the upcoming sections, we will thoroughly explore the major Vedic Sub-Sutras, shedding light on their historical roots and mathematical importance. Each Sub-sutra will be carefully reformulated as a formal theorem, complete with precise definitions and rigorous proofs. While earlier scholars have already provided mathematical justifications for many Vedic Math Sub-sutras, our work will further refine and build upon those foundations.

We will also examine how these theorems impact modern mathematical research and education, emphasizing their possible applications and advantages. Through this effort, we aim to show that the ancient insights contained within Vedic Mathematics are compatible with modern approaches and can greatly enhance contemporary mathematical theory and practice. This paper shows the lasting importance of Vedic methods, providing a link between the ancient traditions and the modern advancements in mathematics.

II. SRI BHARATI KRSNA TIRTHAJI AND VEDIC MATHEMATICS

Jagadguru Shankaracharya Swami Bharati Krsna Tirtha lived between 1884 and 1960. He is credited with reconstructing the ancient system of Vedic Mathematics from certain Sanskrit manuscripts that other scholars had previously dismissed as meaningless. According to him, the Vedic system he rediscovered is founded on sixteen sutras and thirteen sub-sutras, encompassing all areas of mathematics, both pure and applied. The techniques he introduced, along with the straightforward sutras they are based on, are remarkably simple and easy to use. Moreover, the entire system exhibits a coherence and unity rarely seen in traditional mathematical approaches.[5].[6]

Vedic Mathematics is not only a marvel of mathematical techniques but also deeply rooted in logic. Its remarkable nature has earned it a level of recognition that cannot be easily disputed. Because of these exceptional qualities, Vedic Mathematics has extended beyond India's borders and has become a subject of keen research interest internationally. It addresses a wide range of mathematical operations, from fundamental to highly complex problems. In particular, its methods for basic arithmetic are exceptionally straightforward and highly effective.[7], [8].

The Vedic mathematics sutras and sub-sutras are listed below:

Table 1: Sixteen Sutras and Their Corollaries of Vedic Mathematics

Sr.No.	Sutras	Sub-Sutras or corollories
1	Ekādhikena Pūrvena (also a corollary)	Ānurūpyena
2	Nikhilam Navataścaramam Daśatah	Śisyate Śesasamjnah
3	Ūrdhva - tiryagbhyām	Ādyamādyenantyamantyena
4	ParāvartyaYojayet	Kevalaih Saptakam Gunŷat
5	Sūnyam Samyasamuccaye	Vestanam
6	(Ānurūpye) Śūnyamanyat	Yāvadūnam Tāvadūnam
7	Sankalana - vyavakalanābhyām	Yāvadūnam Tāvadūnīkrtya Vargaňca Yojayet
8	Puranāpuranābhyām	Antyayordasake' pi
9	Calanākalanābhyām	Antyayoreva
10	Yāvadūnam	Samuccayagunitah
11	Vyastisamastih	Lopanasthāpanabhyām
12	Śesānyankena Caramena	Vilokanam
13	Sopantyadvayamantyam	Gunitasamuccayah Samuccayagunitah
14	Ekanyūnena Pūrvena	
15	Gunitasamuccayah	
16	Gunakasamuccayah	

III. VEDIC THEOREMS

While Vedic Mathematics sub-sutras are not traditionally classified as "theorems" in the conventional mathematical framework, they can be restated or reformulated within that context. This process involves expressing these ancient mathematical principles using modern mathematical theory's formal and rigorous language. However, given that each sub-sutra encompasses multiple domains and has a wide range of applications, it is primarily the underlying techniques derived from these sub-sutras that lend themselves to formal proof, rather than the sub-sutras themselves.

Here are a few steps to consider when reformulating Vedic Math Sutras as theorems:

- Clearly state the specific conditions and parameters under which the sub-sutra is applicable. This includes identifying the relevant domain (such as natural numbers, integers, etc.) as well as outlining any necessary assumptions or limitations.
- Express the sub-sutra clearly and precisely, using an "if-then" format similar to that of mathematical theorems.
- Present a formal proof of the theorem, using logical reasoning and established mathematical principles to validate the statement step by step.

3.1 Sub-Sutra: Ānurūpyena

3.1.1 Original Meaning

"Proportionality".The sub-sutra Anurupyena is used to simplify complex calculations by applying proportional adjustments to make numbers easier to work with.

3.1.2 Theorem(Ānurūpyena)

If two ratios are given, such that: $\frac{a}{b} = \frac{c}{d}$. Then, you can solve for any unknown variable by cross-multiplying: a.d=b.c.

The domain of this theorem is the set of real numbers a,b,c, and d., where b≠0 and d≠0.

3.2 Sub-Sutra: Śisyate Śesasamjnah

3.2.1 Original Meaning:

"Which remains, is called a reminder".Used to handle remainders in division, recurring decimals, and modular arithmetic.

3.2.2 Theorem(Śisyate Śesasamjnah)

For any two integers a and b with b≠0, there exist unique integers q(quotient) and r(remainder) such that: $a = bq + r$, where 0≤r<│b│Where a,b∈ ℤ(integers) with b≠0.

3.3 Sub-Sutra: Ādyamādyenantyamantyena

3.3.1 Original Meaning

"First by the first and last by the last." Used for multiplying binomials or terms in pairs.

3.3.2 Theorem(Ādyamādyenantyamantyena)

For any real numbers a,b,c,d∈ℝ, the product of two binomials:
(a+b) (c+d) can be expressed as: ac+ad+bc+bd, where a,b,c,d∈ℝ

3.4 Sub-Sutra: Kevalaih Saptakam Gunỹat

3.4.1 Original Meaning

"One should multiply only by seven."Used to simplify division by 7 through multiplication.

3.4.2 Theorem(Kevalaih Saptakam Gunỹat)

Let N∈ℕ and d∈ℕ be a prime number such that the reciprocal 1/d has a repeating decimal. Then, instead of dividing N by d, you can multiply N by the repeating decimal corresponding to 1/d, and adjust the decimal point.

Where N∈ℕ, d∈ℕ (d is a prime number whose reciprocal 1/d has a repeating decimal).

3.5 Sub-Sutra: Yāvadūnam Tāvadūnam

3.5.1 Original Meaning

"Whatever deficiency further lessens that much."Used to indicate continuation until the desired result is achieved.

3.5.2 Theorem(Yāvadūnam Tāvadūnam)

Let N∈ℕ and f: ℕ→ℕ be a function that is applied repeatedly to N until a condition C(N) is satisfied. Define the sequence:
N0=N, Nk+1=f(Nk), for k≥0, and stop when C(Nk)= True.
The operation f is applied repeatedly until the condition C is satisfied.
Where N∈ℕ, f:ℕ→ℕ (a function applied iteratively, such as division, multiplication, etc.), and C(Nk) is a condition that determines when the iteration stops.

3.6 Sub-Sutra: Antyayordasake' pi

3.6.1 Original Meaning

"Sum of last digits is ten". Used when last digits sum to 10 and the preceding digits are equal.

3.6.2 Theorem(Antyayordasake' pi)

If two numbers have identical digits except in the unit place, and their unit digits add to 10, then the product of the numbers is given by:
Let x=10A+a, y=10A+(10-a), then the product is:
x.y=100.A(A+1)+a(10-a) .
where A∈ℕ0 is the common part (digits except unit),
and a∈ {1,2,…,9}

3.6.3 Proof

We start with x=10A+a, y=10A+(10-a)
Now compute x.y:
x.y = (10A+a)(10A+(10-a))
Let's expand: =(10A)2+10A·(10−a)+a·(10A)+a(10−a)
Group like terms:
=100A2+10A(10−a+a)+a(10−a)
Since −a+a=0
=100A2+100A+a(10−a)
Factor the first two terms:
= 100A(A + 1) + a(10 - a)
Hence Proved.

IV. Conclusion

This research has undertaken the task of bridging the ancient insights of Vedic Mathematics with the rigor of modern mathematical theory by deriving formal theorems from selected Vedic sub-sutras. Through systematic analysis, interpretation, and algebraic proof, we have demonstrated that these concise and elegant sutras, often transmitted orally in ancient times, encapsulate mathematically sound principles that are both efficient and applicable even today.

The process of theoremization not only validates the intellectual depth of Vedic Mathematics but also enhances its accessibility to contemporary learners and researchers. By translating qualitative sutras into precise, provable statements, this work opens the door for their integration into modern mathematical education, algorithm design, and cognitive mathematics.

This attempt further illustrates that Vedic sub-sutras—such as Antyayordasake'pi and others—are not merely heuristic tricks but are grounded in robust mathematical logic. Their formalization brings ancient Indian contributions into dialogue with modern mathematical discourse, fostering appreciation for cultural heritage while enriching current computational practices.

Future research can build upon this foundation by exploring more complex sutras, expanding their application to higher mathematics, and developing curriculum models that merge traditional wisdom with contemporary pedagogy. In doing so, we ensure that the legacy of Vedic Mathematics continues to inspire innovation, understanding, and discovery in the mathematical sciences.[9], [10]

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