

International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2024; 9(4): 156-162
© 2024 Stats & Maths
www.mathsjournal.com
Received: 02-07-2024
Accepted: 06-08-2024

Sher Singh Raikhola
Department of Mathematics,
Bhaktapur Multiple Campus,
Tribhuvan University, Nepal

Exploring the applications and efficiency of Vedic mathematics

Sher Singh Raikhola

DOI: <https://doi.org/10.22271/maths.2024.v9.i4b.1788>

Abstract

Vedic Mathematics, derived from ancient Indian texts known as the Vedas, offers a set of concise Sūtras and Sub-Sūtras providing alternative techniques for Arithmetic, Algebra, and Calculus. This study explores the efficiency and applications of Vedic Mathematics across various Mathematical domains. Through a comparative analysis with conventional methods, the research evaluates the effectiveness of Vedic Mathematics in modern Mathematical education and practice. The study highlights the historical importance of Vedic Mathematics and underscores the necessity of incorporating its principles into contemporary Mathematical education.

By examining historical texts and modern research, this paper demonstrates how Vedic Mathematics Sūtras and Sub-Sūtras offer efficient problem-solving techniques for algebra, arithmetic, and calculus, ultimately enhancing computational efficiency and problem-solving abilities. The study demonstrates that Vedic Mathematics Sūtras offer a streamlined and effective methodology for solving classical Mathematical problems. Comparison with conventional algebraic proof methods reveals the unique advantages of Vedic Sūtras, providing a more intuitive and concise approach. Participants show a preference for the clarity and efficiency of Vedic Mathematics in solving classical problems, suggesting its potential as an alternative teaching method.

The research concludes that Vedic Mathematics, with its versatile sutras, can significantly benefit both elementary and advanced Mathematics teaching.

Keywords: Vedic mathematics, sūtras, algebra, arithmetic, calculus, mathematical education, problem-solving

Introduction

Vedic Mathematics, derived from ancient Indian scriptures known as the Vedas, is recognized for its efficiency and applicability across various Mathematical domains. This system, built on concise and easy-to-apply Sūtras and Sub-Sūtras, offers alternative methods for arithmetic, algebra, and calculus, often surpassing conventional techniques in efficiency. This study explores the applications and efficiency of Vedic Mathematics, evaluating its impact on computational efficiency and problem-solving through comparative analysis with conventional methods. We aim to understand its relevance in modern Mathematical education and practice [4, 11].

This research underscores the importance of incorporating Vedic Mathematics into higher education, acknowledging its historical significance in classical Indian sciences, particularly in texts like Vedāṅga Jyotiṣa [12]. Discovered by Jagadguru Shankaracharya Swami Bharati Krishna Tirtha between 1911 and 1918.

Vedic Mathematics is built on sixteen Sūtras that enhance pattern recognition and accelerate computations. These methods offer faster computation techniques compared to traditional methods typically taught in schools [2].

Objectives of Research

To explore the applications and efficiency of Vedic Mathematics in Algebra, Arithmetic and Calculus.

Corresponding Author:
Sher Singh Raikhola
Department of Mathematics,
Bhaktapur Multiple Campus,
Tribhuvan University, Nepal

Research Methodology

This research employs a historical research method to examine and study various works of higher Mathematics and advanced calculus that are based on Vedic Mathematics Sūtras. The methodology involves a comprehensive review of literature on Vedic Mathematics Sūtras and Sub-Sūtras to understand their historical significance and meaning. This examination highlights a significant research gap, as limited work has been conducted in exploring the applications of Vedic Mathematics in higher Mathematics and advanced calculus. After an extensive literature review, two primary references were identified as particularly informative and useful for the research: "Vedic Mathematics" by Swami Sri Bharati Kranti Ji Maharaja, Shankaracharya S.N. of Govardhana Matha, Puri, edited by Dr. V. S. Agrawala, and "Vertically and Crosswise: Applications of Vedic Mathematics Sūtras" by Pickles, Nicholas & Williams. These books serve as essential resources for understanding and analyzing Vedic Mathematics Sūtras and their historical significance in the context of higher Mathematics and advanced calculus.

The link between Vedic Sūtras and Sub-Sūtras to arithmetic, algebra, and calculus was explored by analyzing examples solved using conventional methods and Vedic Mathematics techniques.

Literature Review

This research relies on secondary data, including past research papers, journals, books, and theses. A review of these materials revealed that much of the computer science research has applied Vedic Sūtras and Sub-Sūtras for binary operations like subtraction, multiplication, division, as well as binary squaring and cubing. In the article "Mathematics Hundred Years Before and Now," Acharya, ^[1], looks at the history of Mathematics and how ancient manuscripts have been preserved. Ratna connects old and new ways of thinking about math, discussing how mathematical ideas have changed over time. The article explains how derivatives can be used to solve quadratic equations and shows how the Vertical and Crosswise Sūtra can be used for algebra and exponential functions. It highlights that although the core mathematical concepts have stayed the same, the methods and algorithms used to solve problems have changed.

Babaji ^[3], in "Solving Systems of Linear Equations using the Parāvartya Rule," demonstrates solving linear equations with

the Parāvartya Yojayet Sūtra, extending it to systems of n linear equations. Babaji's research shows that this method is comparable to Cramer's Rule for two equations and more efficient than Gauss elimination and LU Decomposition for three equations. The paper also suggests using the Parāvartya rule multiple times to enhance efficiency.

Swami Sri Bharati Kranti Ji Maharaja's book "Vedic Mathematics" ^[4], edited by V.S. Agrawala, provides practical implementations of Vedic Sūtras across Mathematical disciplines. The book covers multiplication using the Ūrdhva-Tiryagbhyām Sūtra, division with the Parāvartya and Nikhilaṁ Sūtras, and factorization of quadratic equations. It also explains solving cubic equations and simultaneous equations, and the relationship between differential calculus and polynomial factors.

In "Applications of Vedic Mathematics Sūtra – Vertically and Crosswise," Nicholas, ^[8], focus on the Vertically & Crosswise Sūtra. The book shows how to quickly solve arithmetic operations, expand determinants, and simplify matrix operations. The authors provide methods for evaluating determinants and finding matrix inversions, demonstrating the practical efficiency of Vedic Sūtras in simplifying complex computations.

Results and Discussion

Exploring the importance of Vedic Mathematics Sūtras for teaching classical Mathematics revealed their effectiveness in simplifying and expediting problem-solving. These Sūtras streamline approaches, emphasizing mental calculations for increased efficiency. Comparisons with conventional methods showed that Vedic Sūtras offer a more intuitive and concise methodology, aiding quicker understanding and application. Participants preferred the clarity and efficiency of Vedic Sūtras. The findings suggest that incorporating Vedic Sūtras into classical Mathematics teaching could provide a more accessible and efficient learning experience, warranting further research to enhance Mathematics education methodologies.

The Sixteen main Sūtras and Thirteen Sub-Sūtras of Vedic Mathematics are as follows

Vedic Mathematics, based on sixteen sutras from the Atharva Veda, offers an efficient system of computation and problem-solving.

Table 1: Sixteen Shrutras and Sub Shrutras ^[4, 5].

No.	Sutra	Meaning	Sub-Sutra	Calculation Explanation
1	Ekadhikena Purvena	One more than the previous one	Anurupyena	In proportion
2	Nikhilam Navatashcaramam Dashatah	Subtract all from 9 and the last from 10	Sisyate Sesasamjnah	Remainder remains constant
3	Urdhva-Tiryagbhyam	Vertically and Crosswise	Adyam Adyentanyam Antyena	First with first, last with last
4	Paraavartya Yojayet	Transpose and Apply	Kevalaih Saptakam Gunyat	Multiplying by 143 for 7
5	Shunyam Saamyasamuccaye	Sum equals zero	Vestanam	By osculation
6	Anurupye Shunyamanyat	Ratio results in zero	Yavadunam Tavadunam	Reduce by the deficiency
7	Sankalana-vyavakalanabhyam	By addition and subtraction	Yavadunam Tavadunikritya Varga Yojayet	Adjust for deficiency, square the result
8	Puranapuranabhyam	Completion or non-completion	Antyayordashake 'pi'	Last sum equals 10
9	Chalana-Kalanabyham	Differences and similarities	Antyayoreva	Only the last terms
10	Yaavadunam	Extent of deficiency	Samuccayagunitah	Sum of the products
11	Vyashtisamanstih	Part and whole	Lopanasthapanabhyam	Alternate elimination and retention
12	Shesanyakena Charamena	Remainders by last digit	Vilokanam	By mere observation
13	Sopaantyadvayamantyam	Ultimate and penultimate	Gunitasamuccayah Samuccayagunistah	Product of the sum equals sum of the products
14	Ekanyunena Purvena	One less than the previous	Dhvajanka	On the flag
15	Gunitasamuchyah	Product of the sum equals sum of products	Dwandwa Yogiji	
16	Gunakasamuchyah	Factors of the sum equals sum of factors	Adyam Antyam Madhyam	

In this study, the researcher endeavors to elucidate various methods using Sūtras and Sub-Sūtras, demonstrating their connection with Algebra, Arithmetic, and Calculus.

Algebra: ^[4]

1. Ekādhikena Purvena (By one more than the previous one):

The Mathematical rule you provided is called "Ekādhikena Purvena" which translates to "By one more than the previous one." It's a method used for factorization and solving algebraic equations. Example: Given the quadratic equation: $x^2 + 6x + 8 = 0$

Using the Ekādhikena Purvena rule, we rewrite the equation as follows:

$$(x+4)(x+2) = 0$$

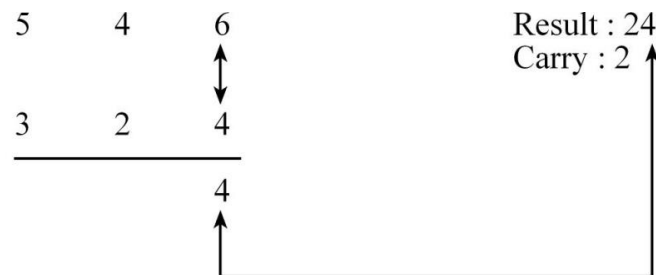
This rewriting comes from noticing that the constant term in the original equation is 8, and we are looking for two numbers whose product is 8 and sum is 6. These numbers are 4 and 2, so we rewrite the middle term of the quadratic equation as $4x + 2x$, which factors into $(x+4)(x+2)$. Now, to find the solutions, we set each factor equal to zero:

$$x+4=0 \Rightarrow x=-4$$

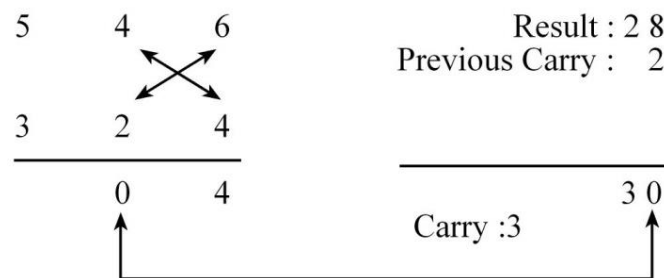
$$x+2=0 \Rightarrow x=-2$$

So, the solutions to the equation $x^2 + 6x + 8 = 0$ are $x = -4$ and $x = -2$.

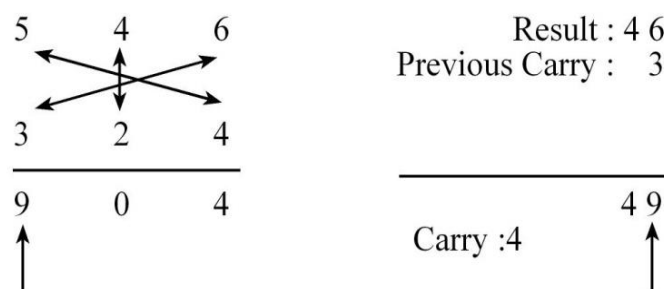
Step 1



Step 2:



Step 3:



2-Urdhva-Tiryagbhyām (Vertically and Crosswise): ^[8].

This rule is particularly useful for algebraic multiplication, especially for polynomials.

Example 1

Given the expression: $(x+5)(x+7)$

Using the "URDHVA-TIRYAGBHYĀM" rule, we multiply the expressions as follows:

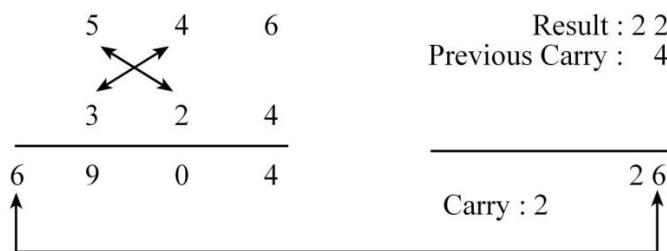
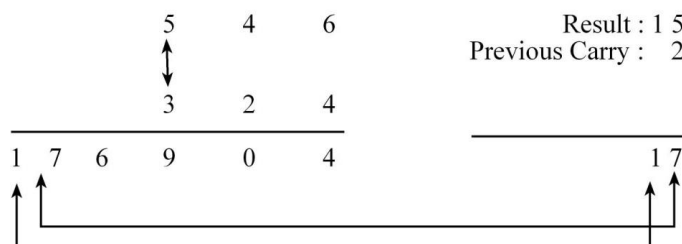
$$(x \times x) + (5 \times 7) + (x \times 7) + (5 \times x) = x^2 + (35 + 7x + 5x) = x^2 + (7x + 5x + 35) = x^2 + 12x + 35$$

So, applying the "URDHVA-TIRYAGBHYĀM" rule to $(x+5)(x+7)$ yields $x^2 + 12x + 35$.

Example 2

Urdhava-Tiryakbhyam

The Urdhava-Tiryakbhyam Sutra, meaning "Vertically and crosswise," is a universal multiplication formula. It emphasizes the parallel process of generating and summing partial products, as illustrated in Fig 1. For example, using this sutra, the multiplication of 546 by 324 results in 176,904.

Step 4:**Step 5:****Fig 1:** Illustration of Vertically and Crosswise multiplication ^[7, 11].

3. Anurūpye Sunyamanyat (If one is in ratio, the other is zero): This Sūtra is particularly useful for solving quadratic equations where one root is the reciprocal of the other.

Example 1

Given the quadratic equation: $x^2 - px + q = 0$ And let a and b be the roots of this equation. According to the properties of the roots:

The sum of the roots, $a + b$, is equal to the coefficient of the linear term with the opposite sign (here p).

The product of the roots, ab , is equal to the constant term (here q).

Given that a is twice b , we have $a = 2b$.

From the sum of roots property: $a + b = p$ $2b + b = p$ $3b = p$ $b = \frac{p}{3}$

From the product of roots property: $ab = q$, $2b^2 = q$, $2 \frac{p^2}{9}$

So, the values of a and b satisfying the given conditions are: $a = 2b$ $b = \frac{p}{3}$ $q = 2 \frac{p^2}{9}$

Thus, the solution is: $a = \frac{2p}{3}$ $b = \frac{p}{3}$ $q = 2 \frac{p^2}{9}$

Hence, if a is twice b , then $a = \frac{2p}{3}$ $b = \frac{p}{3}$, and $q = 2 \frac{p^2}{9}$ ^[6].

4. Puranapuranābhyām (Completion and Non-Completion): This Sūtra is useful for factorization and completing the square.

Example: Example: $x^2 + 10x + 24$

Using the Sūtra: $x^2 + 10x + 25 - 1$

$(x + 5)^2 - 1$ ^[6].

Arithmetic: ^[4].

1. Nikhilam Navatascaramam Dasatah (All from 9 and the last from 10): This Sūtra is useful for subtraction and mental arithmetic.

Example 1: $100 - 87$

Applying the Sūtra: $= (100 - 9) - (87 - 7)$
 $= (100 - 9) - (80)$
 $= 91 - 80$
 $= 11$ ^[2].

Example 2

For example, to determine the complement of the number 543268, subtract it from 1,000,000. To find a number's complement, subtract each digit from 9, and for the final digit, subtract it from 10.

Complement of 543268 can be calculate as

$9999910 - 543268 = 456732$

9999910

$\downarrow \downarrow \downarrow \downarrow \downarrow \downarrow$

543268 Subtract

$= 456732$

The Formula is "All from 9 and the last from 10" ^[4].

Similarly, the Complement of 5486 can be calculate as,

$99910 - 5486 = 4514$ ^[9]

2. Chalana-Kalanābhyām (Differences and Similarities):

This Sūtra is used for addition and subtraction of fractions.

Example:

Let's add $\frac{1}{3}$ and $\frac{2}{5}$

Using the Sūtra "Chalana-Kalanābhyām":

Step 1: Find the common denominator, which is $3 \times 5 = 15$.

Step 2: Adjust the fractions to have the same

denominator: $\frac{1}{3} \times \frac{5}{5} = \frac{5}{15}$ and $\frac{2}{5} \times \frac{3}{3} = \frac{6}{15}$

Step 3: Now, we can add the fractions: $\frac{5}{15} + \frac{6}{15} = \frac{5+6}{15} = \frac{11}{15}$ So,
 $\frac{1}{3} + \frac{2}{5} = \frac{11}{15}$ [6].

Application of Vedic Mathematics Sutras in Calculus

Parāvartya Yojayet (Transpose and Apply): This sutra is useful for differentiation and integration.

Example (Differentiation): $y = x^2$

Applying the Sūtra: $\frac{dy}{dx} = \frac{d}{dx} x^2 = 2x$

So, $\frac{dy}{dx} = 2x$

Example (Integration): $\int (x + a)(x + b) dx = \int (x^2 + (a + b)x + ab) dx$

Applying the Sūtra: $\int (x^2 + (a + b)x + ab) dx = \frac{x^3}{3} + (a+b)\frac{x^2}{2} + abx + C$

So, $\int (x + a)(x + b) dx = \frac{x^3}{3} + (a + b)\frac{x^2}{2} + abx + C$

Here C be a constant of integration

Anurūpye Sunyamanyat (If one is in ratio, the other is zero): This Sūtra is useful in Calculus for optimization problems.

Example: If the product of two numbers is constant, i.e., $xy = k$, then if x increases, y decreases, and vice versa.

Suppose we have two numbers x and y such that their product is constant, denoted as

k , i.e., $xy = k$

Now, if we increase x while keeping y constant, the product xy would exceed k

To maintain $xy = k$, y must decrease.

Conversely, if we increase

y while keeping x constant, the product xy would exceed k .

Again, to maintain $xy = k$,

x must decrease. This principle holds true because of the inverse relationship between

x and y when their product is constant. As one variable increases, the other variable must decrease proportionally to keep their product constant.

This concept is essential in optimization problems in calculus, where we seek to maximize or minimize a function subject to certain constraints. In such problems, understanding how changes in one variable affect another helps in finding the optimal solution.

Example: If the product of two numbers is constant, i.e., $xy = 10$, and we want to maximize the sum $x + y$, we can use calculus.

Express y in terms of x : $y = \frac{10}{x}$, when $xy = 10$.

Formulate the sum S to be maximized: $S = x + y = x + \frac{10}{x}$

Find the derivative of S with respect to x :

To find the maximum or minimum, take the derivative: $\frac{dS}{dx} =$

$$\frac{d}{dx} \left(x + \frac{10}{x} \right) = 1 - \frac{10}{x^2}$$

Set the derivative equal to zero to find the critical points: $1 - \frac{10}{x^2} = 0$ $\frac{10}{x^2} = 1$

$$x^2/10 = 1 \Rightarrow x = \pm \sqrt{10}$$

Since $y = \frac{10}{x}$, the corresponding y values are: $y = 10/\sqrt{10} = \sqrt{10}$ or $y = 10/(-\sqrt{10}) = -\sqrt{10}$

So, the critical points are $(\sqrt{10}, \sqrt{10})$ and $(-\sqrt{10}, -\sqrt{10})$

Therefore, maximum Sum $S = x + y = \sqrt{10} + \sqrt{10} = 2\sqrt{10}$, where $xy = 10$

Sub-Sutras for Calculus: [4].

Lopanasthāpanabhyām (By Alternately Lessening and Restoring): This Sub-Sutra is useful for integration.

Example:

The given example demonstrates the application of the Sub-Sutra "Lopanasthāpanabhyām (By alternately lessening and restoring)" which is useful for integration.

Example: $\int (x^2 + 5x + 6) dx$

Applying the Sub-Sutra:

$$= \int ((x^2 + 5x + 25) - 19) dx$$

$$= \int ((x^2 + 5x + 25) dx - \int 19 dx$$

$$= \frac{x^3}{3} + 5\frac{x^2}{2} + 25x - 19x + C$$

$$= \frac{x^3}{3} + 5\frac{x^2}{2} + 6x + C$$

$$\text{So } \int (x^2 + 5x + 6) dx = \frac{x^3}{3} + 5\frac{x^2}{2} + 6x + C$$

Where C is the constant of Integration.

Vilokanam (The method of observation): This Sub-Sutra is useful for integration.

The given example demonstrates the application of the Sub-Sutra "Vilokanam (The method of observation)" which is useful for integration.

Example: $\int (x^2 + 6x + 8) dx$

Applying the Sub-Sutra:

$$= \int ((x + 3)^2 - 1) dx = \frac{1}{3}(x + 3)^3 - x + C$$

$$\text{So, } \int (x^2 + 6x + 8) dx = \frac{1}{3}(x + 3)^3 - x + C$$

Here C is the constant of Integration.

These Sutras and Sub-Sutras provide efficient methods for differentiation and integration, making calculus computations faster and more straightforward.

Matrices and Determinants: [4, 6]

1. Anurūpyena (Proportionately):

This Sutra is useful for matrix multiplication.

Example:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} ap + br & aq + bs \\ cp + dr & cq + ds \end{bmatrix}$$

Example

$$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} 4 & 2 \\ 3 & 4 \end{bmatrix} \text{Applying the Sūtra:}$$

$$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} (2 \times 4 + 3 \times 3) & (2 \times 2 + 3 \times 4) \\ (4 \times 4 + 5 \times 3) & (4 \times 2 + 5 \times 4) \end{bmatrix}$$

$$= \begin{bmatrix} (8 + 9) & (4 + 12) \\ (16 + 15) & (8 + 20) \end{bmatrix} = \begin{bmatrix} 17 & 16 \\ 31 & 28 \end{bmatrix}$$

2. Śisyate sesāsmjñāh (The final digit remains constant):

This Sūtra is useful for special cases of matrix multiplication.

Example:

$$\begin{bmatrix} 5 & 2 \\ 3 & 7 \end{bmatrix} \times \begin{bmatrix} 6 & 4 \\ 8 & 9 \end{bmatrix} = \begin{bmatrix} 46 & 38 \\ 74 & 75 \end{bmatrix}$$

3. Adyamādyenantyamantyena (First by the first and last by the last):

This Sūtra is useful for finding the determinant of a 3×3 matrix using a Vedic Mathematics Sūtra,

Example

$$\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix} = aei + bfg + cdh - ceg - bdi - afh$$

Example

$$\begin{vmatrix} 2 & 3 & 1 \\ 4 & 1 & 2 \\ 3 & 2 & 1 \end{vmatrix} \text{Applying the Sūtra:}$$

$$\begin{vmatrix} 2 & 3 & 1 \\ 4 & 1 & 2 \\ 3 & 2 & 1 \end{vmatrix} = (2 \times 1 \times 1) + (3 \times 2 \times 3) + (1 \times 4 \times 2) -$$

$$(1 \times 1 \times 3) - (3 \times 1 \times 4) - (2 \times 2 \times 2)$$

$$= (2 + 18 + 8) - (3 + 12 + 8) = 28 - 23 = 5$$

4. Kevalaih Saptakam Gūnyat (By one less than the previous one and the one below)

This Sūtra is useful for finding the determinant of higher-order matrices.

Example:

$$\begin{vmatrix} a & b & c & d \\ e & f & g & h \\ i & j & k & l \\ m & n & o & p \end{vmatrix} = a \begin{vmatrix} f & g & h \\ j & k & l \\ n & o & p \end{vmatrix} - b \begin{vmatrix} e & g & h \\ i & k & l \\ m & o & p \end{vmatrix} +$$

$$c \begin{vmatrix} e & f & h \\ i & j & l \\ m & n & p \end{vmatrix} - d \begin{vmatrix} e & f & g \\ i & j & k \\ m & n & o \end{vmatrix}$$

5. Veṣṭanam (Specific and General)

This Sūtra is useful for special cases of matrix multiplication.

Example:

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} ap + cq & aq + cs \\ bp + dr & bq + ds \end{bmatrix}$$

Example

$$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Applying the Sūtra

$$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} \times \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} (2 \times 1 + 3 \times 3) & (2 \times 2 + 3 \times 4) \\ (4 \times 1 + 5 \times 3) & (4 \times 2 + 5 \times 4) \end{bmatrix}$$

$$= \begin{bmatrix} (2 + 9) & (4 + 12) \\ (4 + 15) & (8 + 20) \end{bmatrix} = \begin{bmatrix} 11 & 16 \\ 19 & 28 \end{bmatrix}$$

6. Yāvadūnam Tāvadūnam (The extent of its deficiency is its deficiency):

This Sūtra is useful for special cases of matrix multiplication.

Example

$$\begin{bmatrix} 3 & 2 \\ 5 & 4 \end{bmatrix} \times \begin{bmatrix} 6 & 5 \\ 8 & 7 \end{bmatrix}$$

Applying the Sūtra

$$\begin{bmatrix} 3 & 2 \\ 5 & 4 \end{bmatrix} \times \begin{bmatrix} 6 & 5 \\ 8 & 7 \end{bmatrix} = \begin{bmatrix} (3 \times 6 + 2 \times 8) & (3 \times 5 + 2 \times 7) \\ (5 \times 6 + 4 \times 8) & (5 \times 5 + 4 \times 7) \end{bmatrix}$$

$$= \begin{bmatrix} (18 + 16) & (15 + 14) \\ (30 + 32) & (25 + 28) \end{bmatrix} = \begin{bmatrix} 34 & 29 \\ 62 & 53 \end{bmatrix}$$

These Sūtras and Sub-Sūtras provide efficient methods for performing matrix multiplication and finding determinants, making matrix computations faster and more straightforward. These step-by-step solutions demonstrate how Vedic Mathematics Sūtras and Sub-Sūtras can be used to solve matrix multiplication and determinant problems efficiently.

For Linear Equation ^[3, 4]**Ekādhikena Purvena (By one more than the previous one) Formula**

Let's solve the equation $2x+3 = 0$ using the Vedic Mathematics sūtra "Ekādhikena Pūrvēṇa" (By one more than the previous one).

Sūtra Explanation

The sūtra "Ekādhikena Pūrvēṇa" suggests solving problems using a method that involves incrementing by one more than the previous value. This sūtra can be applied in various mathematical contexts. Here, we are using it to solve a simple linear equation of the form

$$ax + b = 0.$$

Formula

The general form of the equation is $ax + b = 0$.

To solve for x : $= -b/a$ We need to solve for x .

Solution: Identify a and b : $a=2$, $b = 3$ Apply the formula $x = -b/a$

$$x = -3/2$$

Thus, the solution to the equation $2x + 3 = 0$ is: $= -\frac{3}{2}$

Verification

To verify the solution, substitute $x = -\frac{3}{2}$

back into the original equation: $2(-\frac{3}{2}) + 3 = -3 + 3 = 0$

The left-hand side equals the right-hand side, confirming that $x = -\frac{3}{2}$ is indeed the correct solution.

2. Anurūpye Sunyamanyat (If one is in ratio, the other is zero):

Let's explore the sutra "Anurūpye Sunyamanyat" (If one is in ratio, the other is zero) and apply it to solving the equation $3x=6y$.

Sutra Explanation

The sutra "Anurūpye Sunyamanyat" implies that if two quantities are proportional to each other, then one of them must be zero if the ratio cannot be balanced otherwise. In mathematical terms, if $ax=by$, then either $a=0$ or $b=0$.

Example

Given the equation: $3x = 6y$

We need to solve this using the sutra.

Analyze the given equation: $3x = 6y$

Rewrite the equation to express the proportional relationship: $\frac{x}{y} = \frac{6}{3} = 2$ or $\frac{x}{y} = 2$

This means $x = 2y$.

Apply the sutra "Anurūpye Sunyamanyat":

According to the sutra, either $3 = 0$ or $6 = 0$, which is clearly not possible since both 3 and 6 are non-zero constants. Since both conditions are not possible, we can interpret the sutra in this context to mean that the given proportional relationship $x = 2y$ must hold for non-zero values of x and y .

3. Paravartya Yojayet (Transpose and Apply)

Formula:

If $ax + by = c$, then $x = \frac{c-by}{a}$ or $y = \frac{c-ax}{b}$

Example

Solve the equation $2x + 3y = 9$.

Applying the Sutra: $x = \frac{9-3y}{2}$ or $y = \frac{9-2x}{3}$

4. Yāvadūnam (Whatever the extent of its deficiency)

Formula: If $ax + by = c$, then $x = \frac{c-by}{a}$

Example:

Solve the equation $3x + 2y = 12$.

Applying the sutra: $x = \frac{12-2y}{3}$ or $y = \frac{12-3x}{2}$

These formulas provide efficient methods for solving linear equations, making the process faster and more straightforward.

Conclusions

The study provides a comprehensive overview of the efficiency and applications of Vedic Mathematics in algebra, arithmetic, and calculus. Through a historical research method and comparative analysis with conventional methods, we have demonstrated the unique advantages of Vedic Mathematics in simplifying computations and problem-solving techniques.

The practical examples and literature review underscore the significance of incorporating Vedic Mathematics into higher education to enhance computational efficiency and problem-solving skills among students. By integrating Vedic Mathematics into the curriculum, educators can provide students with valuable tools to tackle complex mathematical problems with ease.

Acknowledgement

I would like to express my heartfelt thanks to Prof. Dr. Chet Raj Bhatt, Prof. N. Pahari, and Prof. Dr. Ajay Singh for their invaluable guidance and insights that greatly influenced this research article. I also appreciate Shyam Raj Subedi for his assistance and encouragement throughout the research process.

References

1. Acharya ER. Mathematics hundred years before and now. History Research. 2015;3(3):41-47. Available from: <http://www.sciencepublishinggroup.com/j/history>
2. Agrawala VS, Bharati Krishna Trithaji Maharaj Sankaracarya of Goverdhan Matha, Puri. *Vedic Mathematics*. 16th reprint ed. Delhi: Motilal Banarsidass Publishers; c2013.
3. Babaji DK. Solving systems of linear equations using the Parāvartya rule. International Journal of Mathematics Trends and Technology. 2012;3(1):37-41.
4. Bharati Krishna Tirtha. *Vedic Mathematics*. Delhi: Motilal Banarsidass Publishers; 1965.
5. Kansara NM. Vedic source of Vedic mathematics. Sambodhi; c2000, 23.
6. Kenneth RW. *Discover Vedic Mathematics*. Delhi: Motilal Banarsidass Publishers; 1984.
7. Kulshreshtha H. Revisiting Vedic math for engineering applications. International Journal of Advanced Research, Ideas, and Innovations in Technology. 2022;8(1):1392.
8. Nicholas A, et al. Applications of Vedic Mathematics Sūtra – Vertically and Crosswise. Publisher; 2010.
9. Raikhola SS, et al. A thematic analysis on Vedic mathematics and its importance. Open Access Library Journal; c2020, 7. DOI: 10.4236/oalib.1106665.
10. Rajaraman V. Historical significance of Vedic mathematics in classical Indian sciences. Indian Journal of History of Science. 1992;27(1):1-13.
11. Raksha, et al. Review on Vedic mathematics. International Journal of Advance Research in Science Communication and Technology (IJARSCT). 2022;3(1).
12. Sarasvati A. Vedanga Jyoutisha: A Treatise on the Science of Vedic Astrology. Delhi: Motilal Banarsidass Publishers; c2000.