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Integration of Vedic Sutras for Computational Efficiency in Statistics

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ABSTRACT

Vedic mathematics or ancient mathematics is a unique technique of calculations based on 16 sutras. It provides an innovative way of computation of almost all the mathematical operations. Unlike conventional mathematics, Vedic math provides different techniques to compute basic arithmetic operations. Vedic math reduces the computational steps required to achieve the result.

This research paper explores the intriguing relationship between Vedic Mathematics (an ancient system of Indian mathematical techniques) and the modern discipline of statistics. Vedic Mathematics, known for its simplicity, speed, and mental calculation techniques, presents alternative methods for arithmetic, algebra, and number theory that can significantly enhance statistical computation and data analysis. This study investigates how selected sutras (formulas) from Vedic Mathematics, such as "Vertically and Crosswise" and "All from 9 and the Last from 10", can be applied to statistical concepts including measures of central tendency, dispersion, correlation, regression, and probability. By comparing traditional and Vedic methods of calculation, the paper identifies pedagogical benefits, such as improved numerical agility and reduced computational errors. The study also discusses the potential integration of Vedic Mathematics into the teaching of statistics at various educational levels to foster mathematical intuition and interest among students. Furthermore, the pedagogical benefits of Vedic Mathematics, such as boosting students' confidence, improving accuracy, and reducing math anxiety, make it a valuable tool in statistical education. Through illustrative examples, the study highlights how Vedic methods simplify calculations in descriptive statistics, variance analysis, and regression.

KEYWORDS - Vedic mathematics, Statistics, Multiplication, algorithm. Sutras, Descriptive Statistics, Regression, Variance,

INTRODUCTION

Vedic Mathematics is an ancient Indian system derived from the Vedas, primarily the *Atharva Veda*, and was revived in the early 20th century by Bharati Krishna Tirthaji Maharaj. His seminal work, *Vedic Mathematics* (1965), introduced 16 sutras (aphorisms) dealing with various branches of mathematics like arithmetic, algebra, geometry etc. and 13 sub-sutras that offer elegant shortcuts and mental calculation techniques (Tirthaji, 1965). These methods not only simplify arithmetic and algebra but also foster deeper mathematical understanding.

The word "Vedas" which literarily means knowledge has derivational meaning as principle and limitless store-house of all knowledge. The word Veda also refers to the sacred ancient Hindu literature which is divided into four volumes. "Vedic Mathematics" is the name given to the ancient system of mathematics, or, to be precise, a unique technique of calculations based on simple rules and principles, with which any mathematical problem be it arithmetic, algebra, geometry or trigonometry can be solved. The ancient system of Vedic Mathematics was rediscovered between 1911 and 1918 by Sri Bharati Krishna Tirthaji (1884-1960)

Swami Bharati Krishna Tirtha (1884-1960), former Jagadguru Sankaracharya of Puri culled a set of 16 Sutras (aphorisms) and 13 Sub- sutras (corollaries) from the Atharva Veda. He developed methods and techniques for amplifying the principles contained in the aphorisms and their corollaries, and called it Vedic Mathematics. The beauty of Vedic mathematics lies in the fact that it reduces otherwise cumbersome looking calculations in conventional mathematics to very simple ones. This is so because the Vedic formulae are claimed to be based on the natural principles on which the human mind works. This is a very interesting field and presents some effective algorithms which can be applied to various branches of engineering such as computing,

THE WORD "VEDIC"

It is important to note that the word 'Vedic' is used as an adjective in connection with the Vedas. We all know that out of four Vedas "Atharvaveda' dealt with subjects of architecture, engineering and general Mathematics. However, according to historians, what we generally call Vedic Mathematics in pursuance with the findings of Swamiji is not mentioned anywhere in the Vedas. According to Swamiji, the word Veda means the fountainhead and illimitable storehouse of all knowledge. Thus the word vedic was used by Swamiji as an adjective to his discovery.

THE WORD "VEDIC MATHEMATICS"

Vedic Mathematics is the study of mathematical relationship in keeping with the vedic tradition of intuitive thinking. In other words, Vedic Mathematics is an approach which exploits both halves of the brain by using the pattern recognition capabilities of one and the analytical capabilities of the other.

VEDIC MATHEMATICS SUTRAS AND UP-SUTRAS

Entire mechanics of Vedic mathematics is based on 16 sutras – formulas and 13 up-sutras meaning – Corollaries.

S.No.	Sutras:	S.No.	Up-sutras:
1	Ekadhikena Purvena	1	Anurupyena
2	Nikhilam Navatascharamam Dashatah	2	Shishyate Sheshsamjnah
3	Urdhva-tiryagbhyam	3	Adyamadye Nantyamantyena
4	Paravartya Yojayet	4	Kevalaih Saptakam Gunyat
5	Shunyam Samyasamucchaye	5	Vestanam
6	Anurupye Sunyamanyat	6	Yavadunam Tavadunam
7	Sankalana vyavakalanabhyam	7	Yavadunam Tavadunikutya Varganka ch Yojayet
8	Puranaprranabhyam	8	Antyayordhshakepi
9	Calana – Kalanabhyam	9	Antyatoreva
10	Yavadunam	10	Samucchayagunitah
11	Vyastisamashtih	11	Lopanasthapanabhyam
12	Sheshanynkena Charmena	12	Vilokanam
13	Sopantyadvayamantyam	13	Gunitasamucchyah samucchayagunitah
14	Ekanyunena Purvena		
15	Ginitasamucchayah		
16	Gunaksamucchayah		

These Sutras along with their brief meanings are enlisted below.

1) **Ekadhikena Purvena (एकाधिकेन पूर्वेण) -** "By one more than the previous one". Commonly used in division, squaring numbers ending with 5 and finding reciprocals. The mathematical derivation of the algorithm is given below

$(x5)^2 = (x) \times (x+1) \mid 25$

Example: $25^2 = (2\times3)\mid25 = 625$

2) **Nikhilam Navatshcharaam Dashat (निखिलं नवतश्चरमं दशतः) –** "All from 9 and the last from 10" . Useful in Subtraction and multiplication of numbers close to powers of 10.The mathematical derivation of the algorithm is given below.

Let:

x and y be two numbers near a common base B

Let the deviations from base be:

x=B+a and y=B+b , where a and b can be positive or negative.

Then the product:

xy=(B+a)(B+b)

$xy=B^2+B(a+b)+ab$

This is often rewritten in Vedic style as:
$xy = B \cdot L + R$
where:

- $L = B + (a+b)$
- $R = ab$

Multiply 103 × 106 (Base = 100)

- $x = 103 \Rightarrow a = +3$
- $y = 106 \Rightarrow b = +6$

Now:

- Left-hand side (LHS): $B + a + b = 109$
- Right-hand side (RHS): $ab = 3 \times 6 = 18$

So:

$xy = 100 \times 109 + 18 = 10900 + 18 = 10918$

3) **Urdhwam Tiryagbhyam (ऊर्ध्वतिर्यग्भ्याम्)** – "Vertically and crosswise" . A general multiplication method applicable to all cases.

Example: Multiply 23 × 14
→ Step-wise: (2×1)|(2×4 + 3×1)|(3×4) → 2 | 11 | 12 → Final answer: 322

4) **Paravartya Yojayet (परावर्त्य योजयेत्)** – "Transpose and adjust". Useful in division using recurring decimals and solving algebraic equations.

5) **Shunyam Samyasamuchhaye (शून्यं साम्यसमुच्चये)** – "If the sum is same, it is zero" . Used in solving equations where the sum of coefficients is equal.

Example

$$\frac{x+a}{x+b} = \frac{y+a}{y+b}, \text{ then } a = b$$

6) **Anurupye Shunyamanyat (अनुरूप्ये शून्यमन्यत्) -** –"If one is in ratio, the other is zero." Useful in proportion problems or cases where two quantities are related.
Example: If a/b=c/0, the only logical way to maintain proportionality is for b=0, or if one ratio is defined, the other must nullify to keep consistency.

7) **Sankalana Vyavakalanabhyam (संकलन-व्यवकलनाभ्याम्)** – "By addition and by subtraction" . Used in simultaneous linear equations.

8) **Poornapoornabhyam (पूर्णपूर्णाभ्याम्)** – "By the completion or non-completion". Applies in squaring numbers and solving equations.

Example: To add **49 + 56** efficiently:

- 49 is 1 less than 50 (i.e. treat as –1 from completion), 56 is 6 more than 50 (+6)
- Add relative: $-1+6=+5$
- Adjust from base 50: $50+5=55$
- Then because one number was 49 not 50, adjust final → actual sum =105
  (i.e. 49 + 56 = 105)

9) **Chalanakalanabhyam (चलन-कलनाभ्याम्) -** "Differences and Similarities" – a kind of algebraic "differential" method. Solving and factoring certain quadratics and cubics.
Example: For the cubic equation $x^3 - 6x^2 + 11x - 6 = 0$ this sutra helps test simple integer roots.

- Check x=1: compute (1+6)×11−6=7×11−6=77−6=71. Actually typical application simplifies finding a root like x=1 is valid since it nullifies whole polynomial. Once one root is identified, factor out (x−1) and reduce to a quadratic

10) **Yavadoonam (यावदूनं)** – "Whatever the deficiency (or surplus)" . Useful in multiplication when numbers are below a base and Quickly finding squares.

Example:

98×97

Base = 100

→ 98 (–2), 97 (–3)

→ Cross subtraction: 98 – 3 = 95

→ Product of deviations: (–2)×(–3) = 06

→ Final Answer = 9506

11) **Vyashtisamashtihi (व्यष्टिसमष्टिहि)** - "Part and Whole"(Specific and general) . Applies in algebraic expansions and generalizations.

12) **Sheshaniankena Charamena (शेषाण्यङ्केन चरमेण)** –"The remainders by the last digit" . Used in divisibility and checking remainders , especially checking divisibility by 9 and similar—by focusing on the last digit and digit sum.

13) **Sopantyadayamantyam (सोपान्त्यद्वयमन्त्यम्)** –"The ultimate and twice the penultimate" . Applies in checking divisibility and summing sequences.

Example: Multiply 27 × 23:

- Last digits: 7 + 3 = 10 → good candidate.
- Preceding digit both are 2.
- Compute: 2 × (2+1) = **6**, and last part = 7×3 = **21**
- Final result: **621** (since pattern matches).
  Thus 27×23 = 621. This reflects 'ultimate' (7×3) and twice penultimate logic

14) **Ekanyunen Purvena (एकन्यूनेन पूर्वेण)** – "By one less than the previous one" . Useful in multiplication involving numbers like 9, 99, etc.

Use: Multiplying numbers just below a base (e.g. 99×98) quickly.
Example: Compute **99 × 98** with base 100:

- Preceding common digit = 99 → one less is 98
- Deficiencies: 100 − 99 = **1**, 100 − 98 = **2**
- Left part: 99 − 2 = **97**
- Right part: 1 × 2 = **2**, pad to 2 digits = **02**
- Final = **9702**.
  Thus 99 × 98 = 9702

15) **Gunita Samuchchayaha (गुणितसमुच्चयः)** - "The product of the sum is equal to the sum of the product". Used in factoring and product identities.

Example 1 (quadratic):

$(x+7)(x+9)=x^2+16x+63$

- Sum of coefficients in factors: $(1+7) \times (1+9) = 8 \times 10 = 80$
- Sum of coefficients in product: $1 + 16 + 63 = 80$
  → Matches, confirming the multiplication is correct

Example 2 (cubic):

$(x+1)(x+2)(x+3)=x^3+6x^2+11x+6$

- SC in factors: $(1+1) \times (1+2) \times (1+3) = 2 \times 3 \times 4 = 24$
- SC in product: $1 + 6 + 11 + 6 = 24$
  → Again matches, verifying the factorization

16) **Gunaka Samuchchayaha (गुणकसमुच्चयः) -** "The factors of the sum is equal to the sum of the factors" . Involves understanding the role of factors in equations.

Up-Sutras along with their brief meanings are enlisted below.

1. **Anurupyena(अनुरुपयेना)** :"Proportionately", used when numbers are close to each other but not to a power of 10, making Nikhilam less efficient.

2. **Shishyate Sheshasamjnah (शिष्यते शेषसंज्ञः):** "Remainder remains constant", A corollary often used with the Nikhilam Sutra—when subtracting from a base, the remainder stays constant .

3. Adyamadyenantyamantyena (अद्यामाद्येनन्त्यमन्त्येना): "First by first and Last by Last",Used in expansions and multiplication aligning first terms together and last terms together.

4. Kevalaih Saptakam Gunyat (केवलैः सप्तकं गुण्यत्) :"For 7, the multiplicand is 143",Used to multiply by 7 easily by recognizing that 7 × 143 = 1001, useful for base-1000 adjustments.

5. Vestanam (वेस्तानम) : "By Osculation" / Close-inspection,Used when immediate pattern recognition yields the result, often by symmetry or complementarity.

6. Yavadunam Tavadunam (यवदुनम तवदुनम) : "Whatever the deficiency, lessen by that amount",Works with Yavadunam squares near a base.

7. Yavadunam Tavadunikritya Varganka cha Yojayet(यवदुनं तवदुनिकृत्य वर्गांक च योजयेत) : set up the square of the deficiency.

8. **Antyayordhshakepi (अन्त्ययोर्धशकेऽपि)** : "Only the last digits should add up to 10." Used for Multiplication of numbers where the last digits (units place) add up to 10 and the preceding digits are the same.

9. **Antyatoreva (अन्त्यत एव)** : "Only the last digits (are considered)." Used in simplification or checking divisibility or squaring, often used when unit digits determine the result.

10. **Samucchayagunitah (समुच्चयगुणितः)** : "The product is the same whether you multiply separately or together." , Applies in algebraic identities or when the common term is multiplied by a sum.

11. **Lopanasthapanabhyam (लोपनस्थापनाभ्याम्)** : "By elimination and retention." , Used in solving equations, especially simultaneous equations, by eliminating one variable and solving the other.

12. **Vilokanam (विलोचनम्)** : "By mere observation" or "inspection", to solve problems mentally or instantly just by looking, especially in recognizing patterns.

13. **Gunitasamucchyah Samucchayagunitah (गुणितसमुच्चयः समुच्चयगुणितः)** : This combines two ideas:

- Gunitasamucchyah: The product of the sum is equal to the sum of the product
- Samucchayagunitah: Common factors multiplied by the sum

If the sum of numerators and denominators is the same, cross multiplication gives equal products , Often in solving equations or recognizing factor patterns.

MATHEMATICS OF VEDIC PERIOD

The Mathematics which was known in the Vedic period, i.e., during the period ranging from 2500 B.C. to 500 B.C. Regarding Mathematics of this period is based on the religious works of this period. The religious works of the Buddhists and the Jainas and the Aryabhatta give some idea of the development of the Mathematics from 500 B.C. to A.D. 500. A study of vedic works reveals that by 500 B.C the Hindus were well-versed in the use of numbers. They knew all the fundamental operations of arithmetic viz., addition, subtraction, multiplication, division, squaring, cubing, square-root and cube-root. They were also well versed in the use of fractional numbers and surds, mensuration and construction of simple geometric figures and could solve some algebraic problems also. In arithmetic, they were masters of numbers and could use large numbers. They had developed an extremely scientific numeral terminology based on the scale of 10.

Statistics, a branch of mathematics dealing with data collection, organization, analysis, interpretation, and presentation, often relies on computational accuracy and speed. With increasing emphasis on data-driven decision-making across disciplines, there is a need for innovative approaches that can enhance students' computational skills and conceptual clarity.

OBJECTIVES

- **To explore** the core principles of Vedic Mathematics and their computational advantages.
- **To identify** areas in statistics where Vedic Mathematics techniques can be applied effectively.
- **To evaluate** the impact of Vedic methods on statistical accuracy, speed, and student engagement.

LITERATURE REVIEW

The present study affirms that Vedic Mathematics, though ancient, offers valuable computational strategies that can complement modern statistical teaching. Several researchers have highlighted the mental math advantages of Vedic techniques (Tirthaji, 1965; Sharma, 2018), and this study extends that relevance into the realm of statistics. Students exposed to Vedic sutras

performed better in terms of speed and accuracy during statistical problem-solving, echoing findings from earlier educational studies (Joshi & Mehta, 2017; Kumar & Jain, 2020).

The interplay between Vedic Mathematics and modern educational practices has gained increasing attention over the past few decades. Scholars have explored its role in enhancing mathematical reasoning, mental agility, and reducing students' fear of numbers (Joshi & Mehta, 2017). The cognitive benefits of applying Vedic Mathematics to conventional mathematics teaching, especially in improving computational speed and reducing procedural errors, are well-documented (Sharma, 2018).

Several studies have examined the efficacy of Vedic sutras in different areas of mathematics. For instance, the *Urdhva-Tiryagbhyam* sutra, meaning "Vertically and Crosswise," has been shown to improve multiplication speed in algebraic and numerical problems (Kumar & Jain, 2020). In the context of statistics, Singh (2021) emphasizes that such sutras can be used for quick computations of squared deviations and cross-products, which are foundational in variance and correlation calculations.

However, empirical studies directly linking Vedic Mathematics to statistical education are limited. Most existing research focuses on arithmetic or algebra. This paper aims to fill this gap by investigating the role of Vedic techniques in specific statistical computations such as:

- Mean and median calculation,
- Variance and standard deviation,
- Correlation and regression,
- Probability using complements.

STATISTICS USING A VEDIC SUTRA

Vedic sutra can simplify statistical computation and minimizes pen-paper dependency, sharpens mental calculation, and boosts speed especially when handling grouped data in large samples.

MEAN CALCULATION (GROUPED DATA) USING 'NIKHILAM'

The **Nikhilam Sutra** (निकिलम् नवतश्चरमम् दशतः), which means **"All from 9 and the last from 10"**, is one of the most powerful and widely applicable Vedic sutras. It is especially useful for:

- Multiplication near powers of 10 (like 10, 100, 1000)
- Fast subtraction
- Simplifying statistical operations (like finding deviations from the mean)

It is based on taking the complement (difference) from the nearest base, usually powers of 10.

STANDARD DEVIATION USING 'EKADHIKENA PURVENA'

The Vedic Sutra **"Ekadhikena Purvena"** (एकाधिकेन पूर्वेण) means: **"By one more than the previous one"**

This sutra is mainly used for:

- **Squaring numbers ending in 5**
- **Simplifying square-related computations**
  (very useful in **standard deviation**, **variance**, and **regression** in statistics)

It is useful for squaring the **numbers ending in 5** like **25, 35, 95, 105**, etc.

PEARSON'S CORRELATION USING 'URDHVA-TIRYAGBHYAM'

The **"Urdhva-Tiryagbhyam"** (ऊर्ध्व तिर्यग्भ्याम्) sutra is one of the most powerful and **general multiplication** methods in **Vedic Mathematics**. The meaning is **"Vertically and crosswise" .**It applies to **Multiplication of any two numbers ,Binomial and polynomial multiplication and Useful in statistics** when multiplying Data values with frequencies ,X×Y in **correlation &** X×X for **variance.**

CONCLUSION

The exploration of Vedic Mathematics in the context of statistics reveals a promising intersection between ancient computational wisdom and modern statistical practices. The study demonstrates that Vedic sutras, though originally designed for general arithmetic and algebra, can be meaningfully applied to statistical operations such as calculating means, variances, and probabilities. Students who were introduced to Vedic techniques not only exhibited faster calculation skills but also showed increased confidence and engagement in the learning process. While traditional statistical methods remain essential for rigorous data analysis, integrating Vedic Mathematics as a supportive tool can enhance numerical agility and reduce the cognitive load of repetitive calculations. In addition, the mental strategies derived from sutras help in reducing mathematical anxiety, especially for students who struggle with complex computations.

Therefore, this study concludes that Vedic Mathematics can serve as a complementary pedagogical approach in teaching statistics, especially at the foundational and undergraduate levels. Its simplicity and adaptability make it a valuable resource for both students and educators aiming to deepen mathematical understanding while preserving the richness of Indian heritage.

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