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Application of Vedic Formulas in Elementary Calculus

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Abstract*:* *In this paper, applications using Vedic mathematics in Calculas is covered. Discovering the Vedic Mathematics' Contribution to Advanced Calculus is the scientist's main objective. Jagadguru Shree Bharti Krishna Tirth ji created Vedic Mathematics between 1884 and 1960, which was descended from the Vedas between 1911 and 1918. Our mathematics are based on sixteen sutras from the Atharva Vedas, according to Shree Bharti Krishna Tirth ji. It is used in a variety of topics, including science, engineering, astrology, astronomy, and others, in addition to basic arithmetic.*

Keywords: Advanced calculus, differentiation, Dhvaja Ghata, vertical and crosswise sutras, and Vedic Sutras

I. INTRODUCTION

Teaching mathematics in schools is mostly done to promote a rational approach to the subject. Mathematics is the foundation of all other sciences. It is essential to everyone's existence. Without the use of mathematics, surviving in daily life is unquestionably difficult. Each and every person uses mathematics in some capacity in daily life. Nearly 2,000 years after the development of the number system, Vedic mathematics emerged in India. In the Rig Veda, Vedic mathematics were created and transmitted via Sutras throughout antiquity. Calculations involving huge numbers are made simpler by using Vedic mathematics. It's possible that calculations employing these Vedic mathematics were made in the past for astrological and astronomical purposes. Shree Jagad Guru Bharti Krishna Tirth ji Maharaj, the founder of Vedic mathematics, discovered the sixteen sutras of mathematics between 1911 and 1918. These sutras from the Atharva Vedas, an old Indian mathematical system, were compiled by Shree Garuda over the course of those six years. Vedic mathematics was developed from these sixteen sutras. The Ganit Sutras, which are well-known for their straightforward mathematical approach, or the Shulabh Sutras are where these sutras are taken from [1]. Calculations involving huge numbers are made simpler by Vedic mathematics. Perhaps employing this Vedic Mathematics, calculations for astrology and astronomy were made in the past. Vedic mathematics simplifies complicated numbers, square and cube roots, auxiliary fractions, and addition, multiplication, and division. It provides solutions in a single line by omitting several stages included in conventional arithmetic. Vedic Math is more streamlined, unified, and quick than the conventional approach, according to Raikhola, Panthi, Acharya, and Jha's research [2]. The relevance of the Vedic practises, according to them, is as follows:

1) Vedic Maths turns a dry subject into a joyful one that everyone can learn about with a smile. It offers flexibility, fun, and immense satisfaction.
2) Vedic Math, with its special attributes, can help to resolve the mental problem of mathematical anxiety.
3) Vedic approaches increase the calculations' speed and precision. Vedic mathematics offers one-line, lightning-fast, and mental processes, as well as quick cross-checking tools.
4) The Vedic sutras provide a complementary, understandable, and fundamental mathematical framework.
5) The development of the Vedic mathematics methodology is a wonderful and fascinating invention that has given rise to various applications in all fields.

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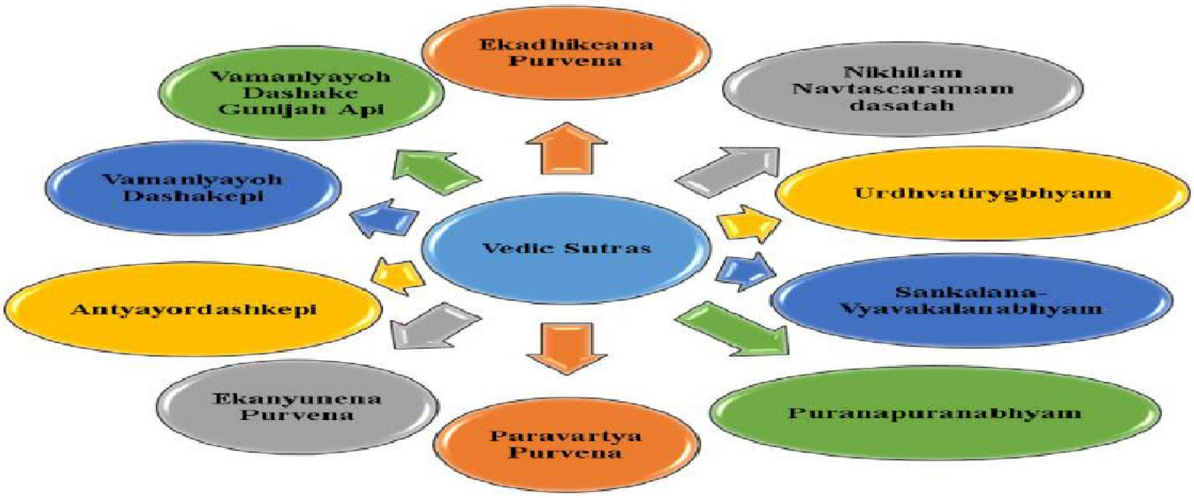
Vedic sutras, according to Mandloi [3], help a person respond to mathematical issues more quickly. It facilitates decision-making for both straightforward and complex problems. Additionally, it lessens the burden of retaining challenging material and enhances a person's focus and willingness to learn and develop his talents.

Vedic mathematics was advanced and developed by Sharma, Khubnan, and Subramanyam [4] with the aim of creating multipliers and algorithms like UrdhvaTiriyagbhyam and Nikhilam, among other things. Additionally, they provide an overview of Vedic Mathematics in conjunction with NEP2020. Vedic sutras were only discussed by Chauhan and Ali [1] in relation to multiplication. As far as we are aware, there has never been a study that combined three different topics into one.

1.1 Application of Vedic Mathematics in Various Field

In this section, we go through a few key Vedic mathematical sutras that are useful for quick calculations and application. We first enumerate the 16 sutras and their sub-sutras before examining how some sutras might be applied to math, algebra, and calculus. These sutras and subsutras are known by the following names [5]:

1) EkadhikinaPurvena (Sub sutra-Anurupyena) Its meaning is "By one more than the preceding one (proportionality)".
2) NikhilamNavatashcaramamDashatah (Sub sutra: SisyateSesasamjnah) All of them are from 9 and the last one is from 10. (Remainder remains constant).
3) Urdhva-Tiryagbyha(Sub sutra:Adyamadyenantya-mantye-na) Vertically and crosswise (First to last and last to first).
4) ParaavartyaYojayet (Sub sutra: KevalaihSaptakamGunyat) Transpose and adjust (The multiplicand for 7 is 143.)
5) ShunyamSaamyasamuccaye (Sub sutra: Vestanam) When the sum is equal that sum is zero (Using Osculation)
6) AnurupyeShunyamanyat (Sub sutra:YavadunamTavadunam) If one variable is in same ratio, the other variable is zero (Lesserdue to a deficiency)
7) Sankalana-vyavakalanabhyam(Sub sutra:YavadunamTavadunam Varga) By addition and by subtraction 8. (Whatever the shortage, multiply it by the amount and square it.)
8) Puranapuranabyham (Sub sutra: Antyayordashake) By the completion or non-completion (Last Totalling 10)
9) Chalana-Kalanabyham (Sub sutra: Antyayoreva) Differences and Similarities (only the last terms)
10) Yaavadunam (Sub sutra: Samuccayagunitah) Whatever the extent of its deficiency (The addition of the coefficients in the product).
11) Vyashtisamanstih(Sub sutra: Lopanasthapanabhyam) Part and Whole (By Alternate Elimination and Retention)
12) ShesanyankenaCharamena (Sub sutra: Vilokanam) The remainders by the last digit (By Mere Observation)
13) Sopaantyadvayamantyam(Subsutra:Samuccayagunitah) The ultimate and twice the penultimate (The Product of the Sum is the Sum of the Products)
14) EkanyunenaPurvena: This sutras states "By one less than the previous one ".
15) Gunitasamuchyah: This sutra means that the multiplication of the sum is equal to the sum of the product
16) Gunakasamuchyah: This sutra states that the additions of the factors is equal to the sum of the factors



II. DIFFERENTIAL CALCULUS

Differential Calculus is crucial for a range of real-world situations where we must determine the rate at which one parameter changes in relation to another. You may calculate the derivative of any function at a given place graphically by drawing an angle there and then calculating the slope. In the event when y = f(x), $\frac{dy}{dx} = f'(x)$

By using Dhvaja Ghata (power)

When solving a quadratic equation, multiply each term's Dhvaja Ghata (power) by its Anka (coefficient), then reduce the result by one.

Example 1: Find First derivative of quadratic expression P = $2x^2 + 5x + 19$

Sol. Let P = $2x^2 + 5x + 19$

As per current method, taking derivative of P w.r.t. x

$\frac{dP}{dx}$= 4x + 5(1) + 0

$\frac{dP}{dx}$= 4x +5

By using Dhvaja Ghata, Finding first differential of each term of quadratic expression $2x^2 + 5x + 19$,

$2x^2$ gives 4x; $5x$ gives 5 and 19 gives zero.

Therefore ,$\frac{dP}{dx}$ = 4x +5.

Calana-Kalanābhyām Sūtra:

This Sutra displays the square root of Discriminant and the Discriminant of the quadratic first differential. The Calculus formula for determining the two roots of a quadratic equation was known to R Bharat Kra. He asserts that the square root of the discriminant in the initial quadratic equation corresponds to the first differential. In order to find the roots of the above quadratic equations, two straightforward equations must be solved.

Example 2: Solve the quadratic equation $x^2 + 5x + 6 = 0$

Sol. The first differential D^1 = 2x + 5 and

The square root of the discriminant is ± √25 -24 = ± √1 = ±1

As per above rule, D^1 = ± √Discriminant.

Therefore 2x + 5 = ±1

Hence x = -2 or x = −3

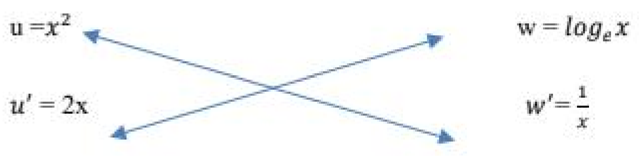
Vertically & crosswise sūtra in solving successive differentiation

Example 3: Find $\frac{dy}{dx} = x^2 log_e x$

By Vedic Technique

Applying standard formula for finding derivative of u and w. By using Vedic Crosswise Sūtra

u =x^2& w = $log_e x$



$$\frac{dy}{dx} = x^2 \frac{1}{x} + 2x\, log_e x = x + 2x log_e x$$

Example 4: Find $\frac{dy}{dx} = (x^2 + 2x + 8)e^x$

u =$(x^2 + 2x + 8)$& w = e^x

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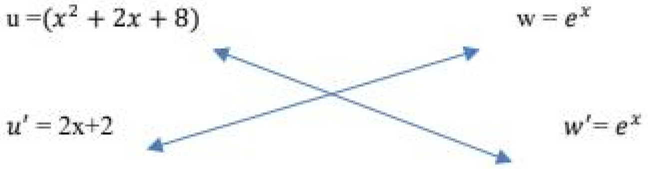
By using Dhvaja Ghata

u'= 2x+2, w'= e^x
By Vedic Technique

Applying standard formula for finding derivative of u and w, By using Vedic Crosswise Sūtra



$\frac{dy}{dx} = (x^2 + 2x + 8)e^x +$ (2x+2) e^x

Derivative of the division of two polynomials

If u and w both are polynomials then by using Vertically & Crosswise Sūtra derivative of division of two polynomial functions can be easily find out.

Example 5: Differentiate y = $\frac{2x+8}{x^2+2x+8}$

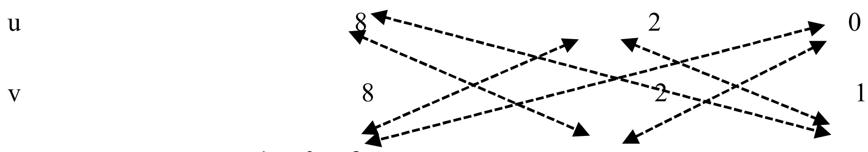
By applying quotient rule, u = 2x+8, v =$(x^2 + 2x + 8)$

$$\frac{dy}{dx} = \frac{(x^2 + 2x + 8)2 - (2x + 8)(2x + 2)}{(x^2 + 2x + 8)^2}$$

$= \frac{(2x^2+4x+16)-(4x^2+20x+16)}{(x^2+2x+8)^2} = \frac{(2x^2+4x+16)-(4x^2+20x+16)}{(x^2+2x+8)^2} = \frac{-2x^2-16x}{(x^2+2x+8)^2}$

The procedure described above is rather time-consuming for determining the derivative of division of two polynomials by crosswise division; however, the numerator of this answer may be quickly determined by utilising the figure below, and the denominator is the square of the term in the denominator.

Coefficient of :$x^0 x^1 x^2$



Let y = $\frac{2x+8}{x^2+2x+8}$ = $\frac{2x^1+8x^0+0x^2}{1x^2+2x^1+8x^0}$. Then

$\frac{dy}{dx} = \frac{[(8*2)-(8*2)](1-0)+ [(8*0)-(8*1)](2-0)x^1+[(0*2)-(1*2)](2-1)x^2}{(x^2+2x+8)^2} = \frac{-16x^1-2x^2}{(x^2+2x+8)^2}$.

Integral Calculus:

The guidance for integration is provided by the "Ekadhika Sutra" Vedic mathematical formula. It states to add one to the "purva" (original index) and divide the coefficient by the new index in order to integrate a power of x.

Example 6:Integrate $5x^2$

Sol. Integration = 5 $\frac{x^3}{3}$

Here, original index is 2 and by "Ekadhika Sutra" we shall have to add 1 with original 2 i.e., 2+1 will be new index of x and also to divide the new index 3.

III. CALCULUS IN VEDIC MATHEMATICS

In 932 A.D., Manjul, a renowned astronomy scholar, was born. Precession of Equinoxes is his most well-known astronomical discovery. Nobody had ever discovered a calculation as precise as his before. He analysed a function in his work "Laghumanas" that has the contemporary mathematical type $u = v \pm e \sin A$, and then he demonstrated that its infinitesimal increment is $du = dv \pm e (\cos A)\, dA$.In 1114 AD, Bhaskaracharya or Bhskar II was born in the South Indian city of Bizapur. From his conclusion, we see that Siny - Sinx approaches to (y - x) Cosy when x approaches y, demonstrating the present version of the sine derivative as $d(\sin \theta) = \cos \theta$. This formula was employed by Bhaskara-II to determine the angle at which the ecliptic was in its position, which is important for eclipse prediction.In the year 1150, he penned the well-known work "SidhantaSiromoni." He said in "SidhantaSiromoni" that

(1) the function's differential vanishes in an instance of the greatest value.

(2) If a function disappears at two places, it also disappears at some differential point that lies in between.

With regard to current calculus, No. 1 introduces the concepts of maxima and minima, while No. 2 introduces the Rolle's theorem. He demonstrated that the equation for the centre vanishes when a planet is at its maximum or minimum distance for this. The differential of the central equation is therefore equal to 0 for some intermediate positions, it is concluded. The generic mean value theorem, which is derived from Rolle's Theorem, thereby takes on a taste.

IV. CONCLUSION

When compared to calculations based on conventional maths, complex and elaborate calculations using Vedic Sutras can be completed with greater accuracy and in less time. Additionally, Vedic mathematics improves memory and significantly heightens mental acuity. Vedic mathematics consistency is its primary characteristic. Vedic mathematical techniques are intriguing alternatives for calculations in a variety of contemporary competitive assessments since they may be learned quickly and with little effort. By using the methods recited in Vedic mathematics, maths can be made easy and pleasurable.

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