INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

IJARIIT

ISSN: 2454-132X
Impact Factor: 6.078
(Volume 7, Issue 5 - V7I5-1308)
Available online at: https://www.ijariit.com

Comparison of Vedic and Modern Maths in Forward Difference by Meru-Prastar

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ABSTRACT

In this paper, we will use the Binomial Theorem in the Forward Difference Operator of Modern Mathematics. On the other hand, Vedic Mathematics offers a new approach to mathematics. If we find the coefficients with the help of the Binomial Theorem, we experience difficulty, when we find the same coefficient with the help of the Vedic method Meruprastra, we get it easily. MeruPrastra method is also known as Pascal's Triangle. Vedic Mathematics reduced efforts by around 50%.

Keywords**—** Meru-Prastar, Vedic Mathematics, Binomial Theorem, Forward Difference Operator

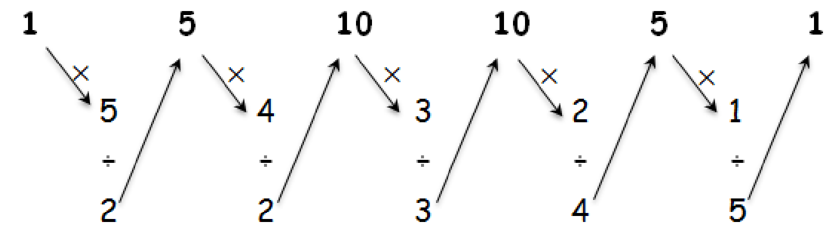
1. INTRODUCTION OF MERU-PRASTARA

A special method for finding the number of combinations, called Meruprastara, is described in Chandah sutras (200 BC). It is the same triangular array commonly known as Pascal's triangle. In modern mathematics, a triangle morphic structure with 1 written on top and two diagonal sides going down to remove the double-term multiples. This array of numbers is known as the pascal triangle the name of French mathematician Blaise pascal. but In Vedic mathematics, the formula for removing double multiples was given only in the third century. Which was called Meru Prastar, where 'Meru' i.e. mountain, and 'prastar' i.e. ladder of the mountain. The first description of the 6 lines of Meru Prastar is in Pingal's verse weapons. The 'merupstar' describing the difference of verses is comparable to the triangle of pascal. The meruprastara rule by Pingal is explained by Halayudh in his mrinta sajivani as follows:

Method of Construction of Meru Prastar -
In Vedic mathematics, the method of removing double factors in meruprastara is given as follows.
$(a + b)^5$ of the factors are:
First, we write reverse counting in the first row and write the straight counting in the second row.

5	4	3	2	1
1	2	3	4	5

Now Write 1 in the first row, then multiply it by 5 and divide it into the second row and write the next number.



1, (1×5÷1=5), (5×4÷2=10), (10×3÷3=10), (10×2÷4=5), (5×1÷5=1)

Fig. 1

Hence, the terms of the multiples will be (1, 5, 10, 10, 5, 1).
Vedic mathematics is considered to be the basis of ancient heritage and knowledge of rishis and munies. Vedic knowledge is completely different from today's western culture. The Orientalists of the West have suppressed Indian knowledge so that Indian

intellectual superiority can be established and permanent sovereignty can be established. Swami Bharati Krishna Tirtha Ji Maharaj, the pioneer of Vedic mathematics, has also included mathematical formulas of Aryabhatta, Brahmagupta to modern-day Ramanuja and Shakuntala Devi through Shulva Sutras, Buddhist texts, Jain texts. In this way, it is also known as ancient mathematics, Indian mathematics.

The signal progress of ancient India is also evident from the first mention of the dichotomy theorem in the distinction of its verses by Pingal verses in the second century B.C.E., which we consider to be Newton's gift today.

2. HISTORY OF THE BINOMIAL THEOREM

The history of the Binomial theorem is very entertaining. It is often believed that Pascal did the work of desiring the Binomial multiplication as a triangle, but Pingle, the third-century Indian mathematician, has used the diverse multiplication beautifully in verses sutra. Which was called 'Meruprastara'. According to Janshruti, it was the Anuj of Panini, He mentions the Meruprastara, the diverse theorem, and the double-edged number; the stalled Chanuimatdha in the verse sutras.

3. SHIFTING OPERATOR (E)

Let $y = f(x)$ be a function of x. By operating E on $f(x)$ we mean to simply give an increment in the value of x in the function $f(x)$. If this increment is denoted by h, then operation of E on $f(x)$ means that put $x + h$ in the function $f(x)$ whenever is x i.e.

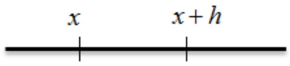


Fig. 2

$$\mathbf{E}f(x) = f(x+h)$$

Or $$\mathbf{E}^2 f(x) = \mathbf{E}f(x+h)$$

=> $$\mathbf{E}^2 f(x) = f(x+2h) \text{ and so on...}$$

Or $$\mathbf{E}^n f(x) = f(x+nh) \text{ n from Natural Numbers}$$

4. FORWARD DIFFERENCE OPERATOR

Let $y = f(x)$ be any function of x. Let the consecutive value if x be $a, (a+h), (a+2h), \ldots (a+nh)$ differing by h. Then the corresponding values y are $f(a), f(a+h), f(a+3h), \ldots f(a+nh)$. The independent variable x is known as argument and the dependent variable y is known as entry. Thus are given a set of values of argument and entry. The number a is the initial value of the argument x *and* $a + nh$ is the last value of x. The number h is called the interval of differencing.

The difference $f(x+h) - f(x)$ is called the first forward difference of the function $f(x)$ at the point x *and* it is denoted by Δ

$$\Delta f(x) = f(x+h) - f(x)$$

=> $$\Delta f(x) = \mathbf{E}f(x) - f(x) \qquad \text{Since } \mathbf{E}f(x) = f(x+h)$$

=> $$\Delta f(x) = (\mathbf{E}-1)f(x)$$

=> $$\Delta = \mathbf{E} - 1$$

=> $$\Delta^2 = (\mathbf{E}-1)^2$$

=> $$\Delta^3 = (\mathbf{E}-1)^3 \text{ and so on...}$$

Or $$\Delta^n = (\mathbf{E}-1)^n \qquad \text{n from Natural Numbers}$$

5. METHODOLOGY

Comparison Table: 1

Binomial Theorem

This Document will be presents an algorithm to perform the binomial coefficients using the difference table

$=>\Delta^5 = (E-1)^5$

$=>\Delta^5 = {}^5C_0E^5(-1)^0 + {}^5C_1E^4(-1)^1 + {}^5C_2E^3(1)^2 + {}^5C_3E^2(1)^3 + {}^5C_4E^1(-1)^4 + {}^5C_5E^0 \ (-1)^5$

$=>\Delta^5 = \frac{(5)!}{(0)!(5-0)!}E^5 - \frac{(5)!}{(1)!(5-1)!}E^4 + \frac{(5)!}{(2)!(5-2)!}E^3 - \frac{(5)!}{(3)!(5-3)!}E^2 + \frac{(5)!}{(4)!(5-4)!}E^1 - \frac{(5)!}{(5)!(5-5)!}E^0$

$=> \Delta^5 = \frac{(5)!}{(5)!}E^5 - \frac{(5)!}{(1)!(4)!}E^4 + \frac{(5)!}{(2)!(3)!}E^3 - \frac{(5)!}{(3)!(2)!}E^2 + \frac{(5)!}{(4)!(1)!}E^1 - \frac{(5)!}{(5)!}E^0$

Meru-Prastar

This Document will be presents an algorithm to perform the binomial coefficients by Vedic Mathematics

$=>\Delta^5 = (E-1)^5$

Coefficient 1, 5, 10, 10, 5, 1

Coefficient	1	5	10	10	5	1

$=>\Delta^5 = E^5 - 5E^4 + 10E^3 - 10E^2 + 5E^1 - E^0$

$=>\Delta^5 f(x) = E^5 f(x) - 5E^4 f(x) + 10E^3 f(x) - 10E^2 f(x) + 5E^1 f(x) - E^0 f(x)$

$=>\Delta^5 f(x) = f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x+0h)$

$\Rightarrow \Delta^5 = E^5 - \frac{5(4)!}{(4)!}E^4 + \frac{5.4(3)!}{(2)!(3)!}E^3 - \frac{5.4(3)!}{(3)!(2)!}E^2 + \frac{5(4)!}{(4)!}E^1 - E^0$

$\Rightarrow \Delta^5 = E^5 - 5E^4 + 10E^3 - 10E^2 + 5E^1 - E^0$

$\Rightarrow \Delta^5 f(x) = E^5 f(x) - 5E^4 f(x) + 10E^3 f(x) - 10E^2 f(x) + 5E^1 f(x) - E^0 f(x)$

$\Rightarrow \Delta^5 f(x) = f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x+0h)$

$\Rightarrow \Delta^5 f(x) = f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x)$

$\Rightarrow \Delta^5 f(x) = f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x)$

Example :(1): Find the missing term in the data:

x	**0**	**1**	**2**	**3**	**4**	**5**
f(*x*)	**?**	**8**	**3**	**-2**	**-1**	**8**

Answer:

Comparison Table: 1

By Modern Method

We are given 6 Values so

$\Rightarrow (E-1)^5 = 0$

$\Rightarrow {}^5C_0 E^5(-1)^0 + {}^5C_1 E^4(-1)^1 + {}^5C_2\ E^3(-1)^2 + {}^5C_3 E^2(1)^3 + {}^5C_4 E^1(-1)^4 + {}^5C_5 E^0(-1)^5 = 0$

$\Rightarrow \frac{(5)!}{(0)!(5-0)!}E^5 - \frac{(5)!}{(1)!(5-1)!}E^4 + \frac{(5)!}{(2)!(5-2)!}E^3 - \frac{(5)!}{(3)!(5-3)!}E^2 + \frac{(5)!}{(4)!(5-4)!}E^1 - \frac{(5)!}{(5)!(5-5)!}E^0 = 0$

$\Rightarrow \frac{(5)!}{(5)!}E^5 - \frac{(5)!}{(1)!(4)!}E^4 + \frac{(5)!}{(2)!(3)!}E^3 - \frac{(5)!}{(3)!(2)!}E^2 + \frac{(5)!}{(4)!(1)!}E^1 - \frac{(5)!}{(5)!}E^0 = 0$

$\Rightarrow E^5 - \frac{5(4)!}{(4)!}E^4 + \frac{5.4(3)!}{(2)!(3)!}E^3 - \frac{5.4(3)!}{(3)!(2)!}E^2 + \frac{5(4)!}{(4)!}E^1 - E^0 = 0$

$\Rightarrow E^5 - 5E^4 + 10E^3 - 10E^2 + 5E^1 - E^0 = 0$

$\Rightarrow E^5 f(x) - 5E^4 f(x) + 10E^3 f(x) - 10E^2 f(x) + 5E^1 f(x) - E^0 f(x) = 0$

$\Rightarrow f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x+0h) = 0$

$\Rightarrow f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x) = 0$

Putting x = 0 and h = 1

$\Rightarrow f(0+5.1) - 5f(0+4.1) + 10f(0+3.1) - 10f(0+2.1) + 5f(0+1) - f(0) = 0$

$\Rightarrow f(5) - 5f(4) + 10f(3) - 10f(2) + 5f(1) - f(0) = 0$

$\Rightarrow 8 - 5(-1) + 10(-1) - 10(3) + 5(8) - f(0) = 0$

$\Rightarrow 8 + 5 - 10 - 30 + 40 - f(0) = 0$

$\Rightarrow 8 + 5 - f(0) = 0$

$\Rightarrow 3 - f(0) = 0$

$\Rightarrow f(0) = 3$

By Vedic Method

We are given 6 Values so

$\Rightarrow (E-1)^5 = 0$

Coefficient	**1**	**5**	**10**	**10**	**5**	**1**

$\Rightarrow E^5 - 5E^4 + 10E^3 - 10E^2 + 5E^1 - E^0 = 0$

$\Rightarrow E^5 f(x) - 5E^4 f(x) + 10E^3 f(x) - 10E^2 f(x) + 5E^1 f(x) - E^0 f(x) = 0$

$\Rightarrow f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x+0h) = 0$

$\Rightarrow f(x+5h) - 5f(x+4h) + 10f(x+3h) - 10f(x+2h) + 5f(x+h) - f(x) = 0$

Putting x = 0 and h = 1

$\Rightarrow f(0+5.1) - 5f(0+4.1) + 10f(0+3.1) - 10f(0+2.1) + 5f(0+1) - f(0) = 0$

$\Rightarrow f(5) - 5f(4) + 10f(3) - 10f(2) + 5f(1) - f(0) = 0$

$\Rightarrow 8 - 5(-1) + 10(-1) - 10(3) + 5(8) - f(0) = 0$

$\Rightarrow 8 + 5 - 10 - 30 + 40 - f(0) = 0$

$\Rightarrow 8 + 5 - f(0) = 0$

$\Rightarrow 3 - f(0) = 0$

$\Rightarrow f(0) = 3$

Example :(2): Find the missing term in the data:

x	**0**	**1**	**2**	**3**	**4**	**5**	**6**
f(x)	**3**	**8**	**?**	**4**	**2**	**8**	**-2**

Answer:

Comparison Table: 3

By Modern Method

We are given 6 so

$\Rightarrow (E-1)^6 = 0$

$\Rightarrow {}^6C_0 E^6(-1)^0 + {}^6C_1 E^5(-1)^1 + {}^6C_2 E^4(-1)^2 + {}^6C_3 E^3(1)^3 + {}^6C_4 E^2(-1)^4 + {}^6C_5 E^1(-1)^5 + {}^6C_6 E^0(-1)^6 = 0$

$\Rightarrow \frac{(6)!}{(0)!(6-0)!}E^6 - \frac{(6)!}{(1)!(6-1)!}E^5 + \frac{(6)!}{(2)!(6-2)!}E^4 - \frac{(6)!}{(3)!(6-3)!}E^3 + \frac{(6)!}{(4)!(6-4)!}E^2 - \frac{(6)!}{(5)!(6-5)!}E^1 + \frac{(6)!}{(6)!(6-6)!}E^0 = 0$

$\Rightarrow \frac{(6)!}{(6)!}E^6 - \frac{(6)!}{(5)!}E^5 + \frac{(6)!}{(2)!(4)!}E^4 - \frac{(6)!}{(3)!(3)!}E^3 + \frac{(6)!}{(4)!(2)!}E^2 - \frac{(6)!}{(5)!}E^1 + \frac{(6)!}{(6)!}E^0 = 0$

$\Rightarrow E^6 - \frac{6(5)!}{(5)!}E^5 + \frac{6.5(5)!}{(2)(4)!}E^4 - \frac{6.5.4(3)!}{(3)!(3)!}E^3 + \frac{6.5(4)!}{(4)!(2)!}E^2 - \frac{6(5)!}{(5)!}E^1 + E^0 = 0$

$\Rightarrow E^6 - 6E^5 + 15E^4 - 20E^3 + 15E^2 - 6E^1 + E^0 = 0$

$\Rightarrow E^6 f(x) - 6E^5 f(x) + 15E^4 f(x) - 20E^3 f(x) + 15E^2 f(x) - 6E^1 f(x) + E^0 f(x) = 0$

By Vedic Method

We are given 6 so

$\Rightarrow (E-1)^6 = 0$

Coefficient	**1**	**6**	**15**	**20**	**15**	**6**	**1**

$\Rightarrow E^6 - 6E^5 + 15E^4 - 20E^3 + 15E^2 - 6E^1 + E^0 = 0$

$\Rightarrow E^6 f(x) - 6E^5 f(x) + 15E^4 f(x) - 20E^3 f(x) + 15E^2 f(x) - 6E^1 f(x) + E^0 f(x) = 0$

$\Rightarrow f(x+6h) - 6f(x+5h) + 15f(x+4h) - 20f(x+3h) + 15f(x+2h) - 6f(x+h) + f(x+0h) = 0$

$\Rightarrow f(x+6h) - 6f(x+5h) + 15f(x+4h) - 20f(x+3h) + 15f(x+2h) - 6f(x+h) + f(x) = 0$

Putting x = 0 and h = 1

$\Rightarrow f(0+6) - 6f(0+5) + 15f(0+4) - 20f(0+3) + 15f(0+2) - 6f(0+1) + f(0) = 0$

$\Rightarrow f(6) - 6f(5) + 15f(4) - 20f(3) + 15f(2) - 6f(1) + f(0) = 0$

=> f(x+6h)-6 f(x+5h)+15f(x+4h)-20 f(x+3h)+15f(x+2h)-6 f(x+h)+f(x+0h) = 0
=> f(x+6h)-6 f(x+5h)+15f(x+4h)-20 f(x+3h)+15f(x+2h)- 6 f(x+h)+f(x) = 0
Putting x = 0 and h = 1
=> f(0+6)-6 f(0+5)+15f(0+4)-20 f(0+3) +15f(0+2)- 6 f(0+1)+f(0) = 0
=> f(6)-6 f(5)+15f(4)-20 f(3)+15f(2)-6f(1) +f(0) = 0
=> -2-6(8)+15(2)-20(4)+15f(2)-6(8)-2 = 0
=> -2-48+30-80+15f(2)-48-2 = 0
=> -50-50+15f(2)-50 = 0
=> 15f(2)-150 = 0
=> 15f(2) = 150
=> f(2) = 10
=> -2-6 (8)+15(2)-20 (4)+15f(2)-6(8)-2 = 0
=> -2-48+30-80+15f(2)-48-2 = 0
=> -50-50+15f(2)-50 = 0
=> 15f(2)-150 = 0
=> 15f(2) = 150
=> f(2) = 10

6. CONCLUSION

we have illustrated that Vedic mathematics more easy comparatively modern mathematics. And our Indian mathematician's worked hard over mathematics but they were not publishing their work so we will not get more about them. But in our old script shows us that our mathematicians discovered almost all the formulas of mathematics before foreign mathematicians.

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