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SIDDHALIC 5/12 AND SIDDHALIC 6/14 RULE IN NUMERICAL INTEGRATION

Siddharth Mishra

Ex-Student, Department of Physics, Banaras Hindu University, UP, (India)

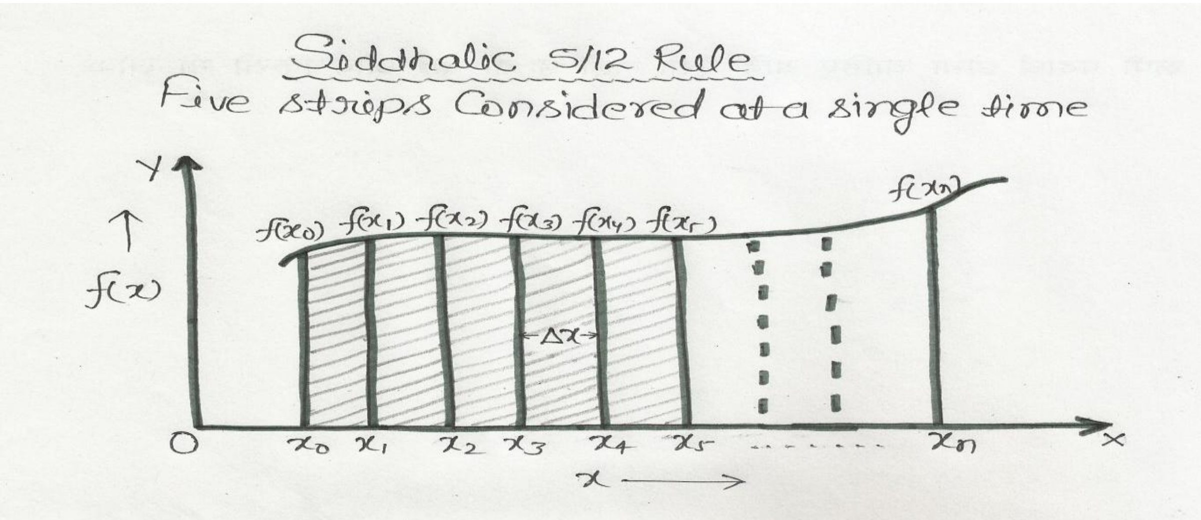
ABSTRACT

Numerical Integration technique involves finding out the value of the integration between the desired limits of any function f(x) numerically. In this regard, there are most famous formula like Mid point rule , trapezoidal rule, Simpson's 1/3rd rule & Simpson's 3/8 rule. These formula are frequently used in calculating the desired integration of the chosen function between the limits. In this perspective, Siddhalic 5/12 & Siddhalic 6/14 rule are going to provide important contribution in evaluating the integrals of any function between the desired limits of integration. These formula are derived employing a new approach or concept which is presented in this paper in a detailed way of expression.

I INTRODUCTION

Here in this paper presented below the Siddhalic 5/12 & Siddhalic 6/14 rules are derived using the basic mathematical way of formulation. The presented formula are derived by employing the definition of arithmetic mean in a precise manner which can be seen thoroughly by insightful inspection of the paper. The two formula are listed in order with their formulation as below

(1). SIDDHALIC 5/12 RULE



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Let us consider a function f(x) as shown in the figure plotted against different values of x namely ; x_0, x_1, x_2, x_3, x_4, x_5 ………..x_n. we have to calculate the value of the integral $_{x0}\int^{xn} f(x)\,dx$, in order to calculate this we divide the whole area into a number of thin strips of equal width Δx, as shown in the figure. Here what we are going to do is considering a combination of five strips at a single time & then calculating the corresponding area as under , writing $y_n = f(x_n)$ we have the area of the first such combination of strips

= Total width of strip combination × average height of strip boundaries

$= (5\Delta x) \times [\{y_0+y_1+y_2+y_3+y_4+y_5\}/6]$

$= (5\Delta x/12) \times \{2y_0+2y_1+2y_2+2y_3+2y_4+2y_5\}$

the above expression can be written as

$= (5\Delta x/12) \times [\{y_0+y_5\}+\{y_1+y_4\}+\{2y_2\}+\{2y_3\}+y_0+y_5+y_1+y_4]$

Now from the definition of arithmetic mean & from the figure above ,if we have

$\{y_0+y_5\}/2 = \{y_1+y_4\}/2 = \{y_2+y_3\}/2$

therefore, $y_0+y_5 = y_1+y_4 = y_2+y_3$, applying this the area of first combination of five strips becomes

$= (5\Delta x/12) \times [\{y_2+y_3\}+\{y_2+y_3\}+2y_2+2y_3+y_0+y_5+y_1+y_4]$

$= (5\Delta x/12) \times [4y_2+4y_3+y_0+y_1+y_4+y_5]$

$= (5\Delta x/12) \times [y_0+y_1+4y_2+4y_3+y_4+y_5]$

similarly for other combination of strips we obtain the expression as

$(5\Delta x/12) \times [y_5+y_6+4y_7+4y_8+y_9+y_{10}]$

………………………………… & so on

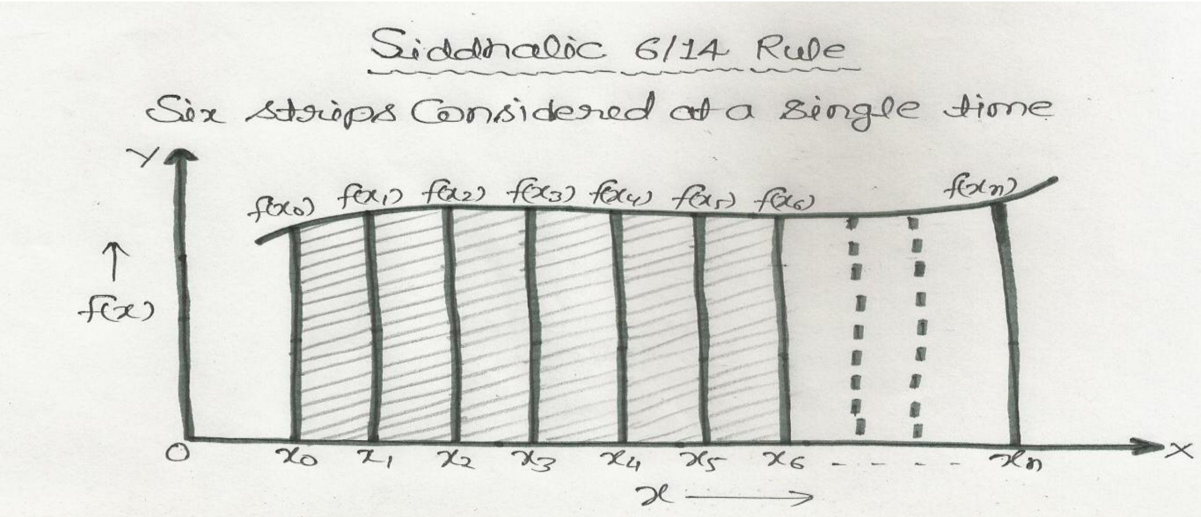
thus adding the combinations final area will be

$_{x0}\int^{xn} f(x)\,dx = (5\Delta x/12) \times [y_0+y_1+4y_2+4y_3+y_4+2y_5+\ldots\ldots.+y_n]$

$_{x0}\int^{xn} f(x)\,dx = (5\Delta x/12) \times [f(x_0)+f(x_1)+4f(x_2)+4f(x_3)+f(x_4)+2f(x_5)+\ldots\ldots\ldots+f(x_n)]$

above formula denotes the Siddhalic 5/12 rule for numerical integration method & can be applied without hesitation

(2). SIDDHALIC 6/14 RULE



Let us consider a function f(x) plotted as shown in figure against the x-values namely ; x_0 ,x_1 ,x_2 ,x_3 , x_4 ,x_5 ,x_6 ……….x_n. In order to evaluate the value of the integral $_{x0}\int^{xn}$ f(x) dx we divide the whole area under the curve into a number of thin strips of equal width Δx. Considering the combination of six such strips at a single time, the area of one such combination of strips

= Total width of strip combination × average height of strip boundaries

$= (6\Delta x) \times [\{y_0+y_1+y_2+y_3+y_4+y_5+y_6\}/7]$

$= (6\Delta x/14) \times [2y_0+2y_1+2y_2+2y_3+2y_4+2y_5+2y_6]$

$= (6\Delta x/14) \times [\{y_0+y_6\}+\{y_1+y_5\}+\{y_2+y_4\}+2y_3+y_0+y_6+y_1+y_5+y_2+y_4]$

Now by the definition of arithmetic mean & from the figure, if we have

$(y_0+y_6)/2 = (y_1+y_5)/2 = (y_2+y_4)/2 = y_3$

or

$y_0+y_6 = y_1+y_5 = y_2+y_4 = 2y_3$

applying this the area of first combination of six strips becomes

$= (6\Delta x/14) \times [2y_3+2y_3+2y_3+2y_3+y_0+y_6+y_1+y_5+y_2+y_4]$

$= (6\Delta x/14) \times [y_0+y_1+y_2+8y_3+y_4+y_5+y_6]$

similarly for the other combination of strips we obtain the expression as follows

$(6\Delta x/14) \times [y_6+y_7+y_8+8y_9+y_{10}+y_{11}+y_{12}]$

…………………………………… & so on

Thus adding the combinations final area will be

$_{x0}\int^{xn} f(x)\, dx = (6\Delta x/14) \times [y_0+y_1+y_2+8y_3+y_4+y_5+2y_6+\ldots\ldots\ldots\ldots+y_n]$

$_{x0}\int^{xn} f(x)\, dx = (6\Delta x/14) \times [f(x_0)+f(x_1)+f(x_2)+8f(x_3)+f(x_4)+f(x_5)+2f(x_6)+\ldots\ldots.+f(x_n)]$

the above expression denotes the Siddhalic 6/14 rule for numerical integration method & is applicable in numerical analysis undoubtedly.

II CONCLUSION

Thus by the employed method we have obtained the Siddhalic 5/12 & Siddhalic 6/14 rule for numerical integration method. These formula can be used with the ease of method without any formulation doubt because employing the above concept or approach , the famous simpson's 1/3rd rule & simpson's 3/8 rule can also be derived which ensures strong support to this method of derivation.