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Certification

This is to certify that this project was carried out by **Wisdom** of Matriculation Number 17/56EB0, for the award of Bachelor of Science B.Sc (Hons) degree in the Department of Mathematics, Faculty of Physical sciences, University of Ilorin, Ilorin, Nigeria.

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All thanks to God the Almighty, the one who is and will forever be, the one and only true God, for all He was done for me throughout the course of my academic journey in the University of Ilorin. May the name be praised forever.

ABSTRACT

This project work is concerned with

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3.1 Solved Examples on Rectangle Rule

3.1.1 Example 1

Using Rectangle rule, solve

$$I = \int_1^3 \left(x^3 - 2x^2 + 7x - 5\right) dx$$

Solution

$$f(x) = x^3 - 2x^2 + 7x - 5$$

$$b = 3, \quad a = 1$$

$$\text{Rectangle rule} = b - af(a)$$

$$
\begin{aligned}
&= (3-1)(1^3 - 2(1)^2 + 7(1) - 5) \\
&= (2)(1-2+7-5) \\
&= (2)(1) \\
&= 2
\end{aligned}
$$

3.1.2 Example 2

Using Rectangle rule, solve

$$I = \int_0^1 \left(x^3 + 3x + 1\right) dx$$

Solution

$$f(x) = x^3 + 3x + 1$$

$$b = 1, \quad a = 0$$

$$\text{Rectangle rule} = b - af(a)$$

$$
\begin{aligned}
&= (1-0)(0^3 + 3(0) + 1) \\
&= (1)(1) \\
&= 1
\end{aligned}
$$

3.1.3 Example 3

Using Rectangle rule, solve

$$I = \int_2^5 \left(x^5 + 2x^4 + 3x^2 + 2\right) dx$$

Solution

$$f(x) = x^5 + 2x^4 + 3x^2 + 2$$

$$b = 5, \quad a = 2$$

$$\text{Rectangle rule} = b - af(a)$$

$$\begin{aligned}
&= (5-2)(2^5 + 2(2)^4 + 3(2)^2 + 2) \\
&= (3)(32 + 32 + 12 + 2) \\
&= (3)(78) \\
&= 234
\end{aligned}$$

3.2 Solved Examples on Midpoint Rule

3.2.1 Example 1

Using Midpoint rule, solve

$$I = \int_1^3 \left(x^3 - 2x^2 + 7x - 5\right) dx$$

Solution

$$f(x) = x^3 - 2x^2 + 7x - 5$$

$$b = 3, \quad a = 1$$

$$\text{Midpoint rule} = b - af\left(\frac{a+b}{2}\right)$$

$$
\begin{aligned}
&= (3-1)f\left(\frac{1+3}{2}\right) \\
&= (3-1)f\left(\frac{4}{2}\right) \\
&= (2)f(2) \\
&= (2)(2^3+2(2)^2+7(2)-5) \\
&= (2)(9) \\
&= 18
\end{aligned}
$$

3.2.2 Example 2

Using Midpoint rule, solve

$$I = \int_0^1 \left(x^3+3x+1\right) dx$$

Solution

$$f(x) = x^3+3x+1$$

$$b = 1, a = 0$$

$$\text{Midpoint rule} = b - af\left(\frac{a+b}{2}\right)$$

$$
\begin{aligned}
&= (1-0)f\left(\frac{0+1}{2}\right) \\
&= (1)f\left(\frac{1}{2}\right) \\
&= (1)\left(\left(\frac{1}{2}\right)^2 + 3\left(\frac{1}{2}\right) + 1\right) \\
&= (1)\left(\frac{1}{8} + \frac{3}{2} + 1\right) \\
&= \frac{21}{8}
\end{aligned}
$$

3.2.3 Example 3

Using Midpoint rule, solve

$$I = \int_2^5 \left(x^5 + 2x^4 + 3x^2 + 2\right) dx$$

Solution

$$f(x) = x^5 + 2x^4 + 3x^2 + 2$$

$$b = 5, a = 2$$

$$\text{Midpoint rule} = b - af\left(\frac{a+b}{2}\right)$$

$$
\begin{aligned}
&= \quad (5-2)f\left(\frac{2+5}{2}\right)\\
&= \quad (3)f\left(\frac{7}{2}\right)\\
&= \quad (3)\left(\left(\frac{7}{2}\right)^5 + 2\left(\frac{7}{2}^4\right) + 3\left(\frac{7}{2}\right)^2 + 2\right)\\
&= \quad (3)\left(\frac{27651}{32}\right)\\
&\Longrightarrow \quad \frac{82953}{32}
\end{aligned}
$$

3.3 Solved Examples on Trapezoidal Rule

3.3.1 Example 1

Using trapezoidal rule, solve

$$I = \int_1^3 \left(x^3 - 2x^2 + 7x - 5\right) dx$$

Solution

$$f(x) = x^3 - 2x^2 + 7x - 5$$

$$b = 3, \quad a = 1$$

$$\text{Trapezoidal rule} = \frac{1}{2}(b-a)[f(a) + f(b)]$$

$$\implies \quad \frac{1}{2}(3-1)\left[(1^3-2(1)^2+7(1)-5)+(3^3-2(3)^2)+7(3)-5)\right]$$

$$\implies \quad \frac{1}{2}(2)\left[(1-2+7-5)+(27-18+21-5)\right]$$

$$\implies \quad [1+25]$$

$$\implies \quad 26$$

3.3.2 Example 2

Using trapezoidal rule, solve

$$I = \int_0^1 \left(x^3+3x+1\right) dx$$

Solution

$$f(x) = x^3+3x+1$$

$$b = 1, \quad a = 0$$

$$\text{Trapezoidal rule} = \frac{1}{2}(b-a)[f(a)+f(b)]$$

$$\implies \quad \frac{1}{2}(1-0)[(0^3+3(0)+1)+(1^3+3(1)+1)]$$

$$\implies \quad \frac{1}{2}(1)[1+5]$$

$$\implies \quad \frac{1}{2}[6]$$

$$\implies \quad 3$$

3.3.3 Example 3

Using trapezoidal rule, solve

$$I = \int_{2}^{5} \left(x^5 + 2x^4 + 3x^2 + 2\right) dx$$

Solution

$$f(x) = x^5 + 2x^4 + 3x^2 + 2$$

$$b = 2, \quad a = 5$$

$$\text{Trapezoidal rule} = \frac{1}{2}(b-a)[f(a) + f(b)]$$

$$\implies \quad \frac{1}{2}(5-2)[(2^5 + 2(2)^4 + 3(2)^2 + 2) + (5^5 + 2(5)^4 + 3(5)^2 + 2)]$$

$$\implies \quad \frac{1}{2}(3)[(32 + 32 + 12 + 2) + (3125 + 1250 + 75 + 2)]$$

$$\implies \quad \frac{3}{2}[78 + 445]$$

$$\implies \quad \frac{3}{2}[4530]$$

$$\implies \quad \frac{13590}{2}$$

$$\implies \quad 6795$$

3.4 Solved Examples on Simpson's Rule

3.4.1 Example 1

Using Simpson's rule, solve

$$I = \int_{1}^{3} \left(x^3 - 2x^2 + 7x - 5\right) dx$$

Solution

$$f(x) = x^3 - 2x^2 + 7x - 5$$

$$b = 3, \quad a = 1$$

$$\text{Simpson's rule} = \frac{b-a}{6}\left[f(a) + 4f\left(\frac{a+b}{2}\right) + f(b)\right]$$

$$\implies \quad \frac{3-1}{6}\left[(1^3 - 2(1)^2 + 7(1) - 5) + 4f\left(\frac{1+3}{2}\right) + (3^3 - 2(3)^2) + 7(3) - 5\right]$$

$$\implies \quad \frac{2}{6}\left[(1 - 2 + 7 - 5) + 4(2^3 - 2(2)^2 + 7(2) - 5) + (27 - 18 + 21 - 5)\right]$$

$$\implies \quad \frac{1}{3}[1 + 36 + 25]$$

$$\implies \quad \frac{62}{3}$$

3.4.2 Example 2

Using Simpson's rule, solve

$$I = \int_0^1 \left(x^3 + 3x + 1\right) dx$$

Solution

$$f(x) = x^3 + 3x + 1$$

$$b = 1, \quad a = 0$$

$$\text{Simpson's rule} = \frac{b-a}{6}\left[f(a) + 4f\left(\frac{a+b}{2}\right) + f(b)\right]$$

$$\implies \quad \frac{1-0}{6}\left[(0^3+3(0)+1)+4(\frac{0+1}{2})+(1^3+3(1)+1)\right]$$

$$\implies \quad \frac{1}{6}\left[1+4\left(\frac{1}{2}\right)+5\right]$$

$$\implies \quad \frac{1}{6}\left[1+4\left(\frac{1}{8}+\frac{3}{2}+1\right)+5\right]$$

$$\implies \quad \frac{1}{6}\left[\frac{33}{2}\right]$$

$$\implies \quad \frac{11}{4}$$

3.4.3 Example 3

Using Simpson's rule, solve

$$I=\int_2^5 \left(x^5+2x^4+3x^2+2\right)dx$$

Solution

$$f(x)=x^5+2x^4+3x^2+2$$

$$b=5, \quad a=2$$

$$\text{Simpson's rule} = \frac{b-a}{6}\left[f(a)+4f\left(\frac{a+b}{2}\right)+f(b)\right]$$

$$\implies \quad \frac{5-2}{6}\left[(2^5+2(2)^4+3(2)^2+2)+4f\left(\frac{7}{2}\right)+(3125+1250+75+2)\right]$$

$$\implies \quad \frac{3}{6}\left[78+\frac{27651}{32}+4452\right]$$

$$\implies \quad \frac{1}{2}\left[\frac{172611}{32}\right]$$

$$\implies \quad \frac{172611}{64}$$

3.5 Solved Examples on Corrected Trapezoidal Rule

3.5.1 Example 1

Using corrected trapezoidal rule, solve

$$I = \int_1^3 \left(x^3 - 2x^2 + 7x - 5\right) dx$$

Solution

$$f(x) = x^3 - 2x^2 + 7x - 5$$

$$f'(x) = 3x^2 + 4x + 7$$

$$b = 3, \quad a = 1$$

$$\text{Corrected trapezoidal rule} = \frac{b-a}{2}\Big[f(a) + f(b)\Big] + \frac{(b-a)^2}{12}\Big[f'(a) - f'(b)\Big]$$

$$\implies \quad \frac{3-1}{2}\left[(1^2 - 2(1)^2 + 7(1) - 5) + (3^3 - 2(3)^2 + 7(3) - 5)\right]$$
$$+\frac{(3-1)^2}{12}\left[(3(1)^2 - 4(1) + 7) - (3(3)^2 - 4(3) + 7)\right]$$

$$\implies \quad 1\Big[(1 - 2 + 7 - 5) + (27 - 18 + 21 - 5)\Big] + \frac{4}{12}\Big[(3 - 4 + 7) - (27 - 12 + 7)\Big]$$

$$\implies \quad \Big[1 + 25\Big] + \frac{1}{3}\Big[6 - 22\Big]$$

$$\implies \quad 26 + \left(-\frac{16}{3}\right)$$

$$\implies \quad 26 - \frac{16}{3}$$

$$\implies \quad \frac{62}{3}$$

3.5.2 Example 2

Using corrected trapezoidal rule, solve

$$I = \int_0^1 \left(x^3 + 3x + 1\right) dx$$

Solution

$$f(x) = x^3 + 3x + 1$$

$$f'(x) = 3x^2 + 3spsb = 1, \quad a = 0$$

$$\text{Corrected trapezoidal rule} = \frac{b-a}{2}\Big[f(a) + f(b)\Big] + \frac{(b-a)^2}{12}\Big[f'(a) - f'(b)\Big]$$

$$\implies \quad \frac{1-0}{2}\left[(0^3 + 3(0) + 1) + (1^3 + 3(1) + 1)\right]$$
$$+\frac{(1-0)^2}{12}\left[(3(0)^2 + 3) - (3(1)^2 + 3)\right]$$

$$\implies \quad \frac{1}{2}\left[(1) + (5)\right] + \frac{1}{2}\left[3 - 6\right]$$

$$\implies \quad \frac{1}{2}\left[6\right] + \frac{1}{12}\left[-3\right]$$

$$\implies \quad 3 - \frac{3}{12}$$

$$\implies \quad \frac{11}{4}$$

3.5.3 Example 3

Using corrected trapezoidal rule, solve

$$I = \int_2^5 \left(x^5 + 2x^4 + 3x^2 + 2\right) dx$$

Solution

$$f(x) = x^5 + 2x^4 + 3x^2 + 2$$

$$f'(x) = 5x^4 + 8x^3 + 6x$$

$$b = 5, \quad a = 2$$

$$\text{Corrected trapezoidal rule} = \frac{b-a}{2}\Big[f(a) + f(b)\Big] + \frac{(b-a)^2}{12}\Big[f'(a) - f'(b)\Big]$$

$$\implies \quad \frac{5-2}{2}\left[(2^5 + 2(2)^4 + 3(2)^2 + 2) + (5^5 + 2(5)^4 + 3(5)^2 + 2)\right]$$

$$+\frac{(5-2)^2}{12}\left[(5(2)^4 + 8(2)^3 + 6(2)) + (5(5)^4 + 8(5)^3 + 6(5))\right]$$

$$\implies \quad \frac{3}{2}[(32 + 32 + 12 + 2) + (3125 + 1250 + 75 + 2)]$$

$$+\frac{3}{4}\,[(80 + 64412) - (3125 + 1000 + 30)]$$

$$\implies \quad \frac{3}{2}[78 + 4452] + \frac{3}{4}[156 - 4155]$$

$$\implies \quad \frac{13590}{2} + \left(\frac{-11997}{4}\right)$$

$$\implies \quad \frac{13590}{2} - \frac{11997}{4}$$

$$\implies \quad \frac{15183}{4}$$

Chapter 4

THE NEWTON-COTES FORMULAE

4.1 DISCUSSION OF RESULTS

Chapter 5

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

5.2 CONCLUSION

In the course of this study,

5.3 RECOMMENDATION

Based on what we have considered in this study,

It is recommended that a formulae be done so that it value could be compare with the most accurate of the closed Newton-Cotes Formulae.

REFERENCES

A.